

# Aviation Week & Space Technology

By [illegible]

By [illegible]

June 11, 1962

**SPECIAL REPORT:**

## Air Force 463L Cargo System

Sikorsky S-64 Skycrane



## NEW MATERIALS, STRUCTURES, PRODUCTS FOR LAND, SEA, AIR, AND SPACE

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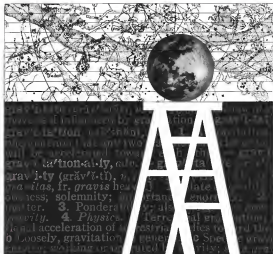


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**AEROJET-GENERAL CORPORATION**  
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The men of Aerospace probe all disciplines of the space sciences. Chartered exclusively to serve the United States Government, Aerospace Corporation applies the full resources of modern science and technology to advanced space and ballistic missile systems. () As part of the Air Force-science-industry team, the men of Aerospace evaluate and stimulate the free flow of information that results in the imaginative concepts required for national leadership in space. From concept to operations and beyond, Aerospace provides advanced systems analysis and planning, theoretical and experimental research, general systems engineering and corresponding technical direction of programs. () Aerospace Corporation, an equal opportunity employer, now seeks more men to meet these responsibilities. Highly skilled engineers and scientists with advanced degrees, knowledgeable in interdisciplinary problem solving, are urged to contact Mr. Charles Ledwick, Room 100, Aerospace Corporation, P.O. Box 99061, Los Angeles 45, California. () Organized in the public interest and dedicated to providing objective leadership in the advancement and application of science and technology for the United States Government.

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but a supply team  
'way back in Texas  
helped bring them together  
in San Francisco via...*

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AIRLINES** 

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Oklahoma City, Tulsa, St. Louis, Kansas City, and Denver



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## AEROSPACE CALENDAR

(Continued from pag. 7)

- Aug. 21-24—Quarterly Report Meeting  
of Local Transport Vehicle Work  
and Build, Augsburg, Ala.
- Aug. 23-24—Conference on Data Link  
Columbus, Ohio; General Systems, Ohio  
Sponsor: Solid State Electronic Laboratory, University of Denver Research  
Institute.
- Aug. 27-29—AIEE Technical Conference  
on Advanced Electronic Materials, Rupp  
Hall, Franklin Hotel, Philadelphia, Pa.
- Aug. 27-Sept. 3—First International Con-  
gress, International Council of the Aero-  
nautical Sciences, New Campus Hall,  
Stockholm, Sweden.
- Aug. 28-29—Fourth Conference on Vibration  
of Electronic Equipment, Elmer  
Tower, Redwood Ave., in cooperation  
with Department of Defense, University  
of California, Riverside, Calif.
- Sept. 3-7—National Advanced Technology  
Management Conference, Institute of Re-  
search Engineers, Seattle, Wash.
- Sept. 3-7—International Symposium on In-  
formation Theory, Institute of Radio En-  
gineers, Research, Japan.
- Sept. 10-12—IEEE Power, Machine, and En-  
gineering, Society of British Aircraft Construc-  
tion, Farnborough, England.
- Sept. 17-18—Symposium on Measurement of  
Thermal Radiation Properties of Solids,  
Baltimore Hotel, Dallas, Ohio. Sponsors:  
Aeronautical Systems Division, USAF, Na-  
tional Bureau of Standards, NBSA.
- Sept. 30-31—Fourth National Conference on  
Applied Microelectronics, American Nuclear  
Energy Society, Hingham, Va.
- Sept. 19-24—Aerospace Ground Meeting in  
International Air Transport Assn., Dublin.
- Sept. 21-24—1966 Annual Engineering Man-  
agement Conference, 1541 Hotel Rouse-  
au, New Orleans, La.
- Sept. 27-30—Hydraulic & Air Control Sys-  
tems Meeting, Institute of the Aerospace  
Sciences, Sheraton Hotel, Washington.
- Sept. 18-23—1966 National Convention of  
Aerospace Personnel, Air Force Arm., Los  
Vegas, Nev.
- Sept. 19-23—Technical Management Utili-  
ties Meeting, Institute of the Aerospace  
Sciences, Hotel Commodore, New York.
- Sept. 19-25—Operations & Maintenance  
Symposium, Aerovak Corp., Mobile, Ala.
- Sept. 19-25—Second International Aircraft  
and Aviation Congress, National Agri-  
cultural School, Gagnoa, France.
- Sept. 24-26—14th International Aerospace  
Congress, American Rocket Society,  
Seattle, England.
- Sept. 25-26—Power Systems Conference,  
American Rocket Society, Veterans Hotel,  
Seattle, Minn., Calif.
- Sept. 26-28—Symposium of Experimental Test  
Methods, North Texas State University,  
Denton, Texas. (Held Hotel, Be-  
verly Hills, Calif.)
- Oct. 28-30—Symposium on Dynamics of  
Maneuvered Flight, Franklin Hotel, Phila-  
delphia, Pa. Aeronautical Institute for re-  
searchers, Engineers, M. Scott, General  
Chairman, Room 470214, General Electric  
Co., 5000 Valley Forge, Space  
Technology Center, 1001  
John F. Kennedy Airport, New York.

PROTECT

THE  
60-G  
MAN



Preventing injury to specimen at impacts of 60 g's is a problem  
facing the technical staff at Chance Vought Aircraft, Vought corp.  
needs have designed an advanced experimental restraint system  
intended to keep men unharmed in hard landings and thrust  
accelerations which could be fatal with current systems. Still, this  
is just one of Vought's projects requiring skilled and imaginative  
scientists and engineers. Like you, perhaps. Current programs  
include SCOUT, SLAM, SATURN, CRUSADER, VIGOR, If you  
are ready to meet the challenge, look into openings with Vought,  
and aerospace leader offering opportunities for a full and rewarding  
future in DYNAMICS, Flutter and vibration, acoustic and vibra-  
tional environments, control dynamics and fluid mechanics.  
**AERODYNAMICS** Aircraft, missile or launch vehicle configuration  
design, stability and control, airloads and aerodynamic heating.  
**POWER AND ENVIRONMENT** Provide solutions to problems relating  
to thermodynamics, heat transfer and fluid flow from preliminary  
design through production follow up. **TRAJECTORIES ANALYSIS**  
Vehicle performance analysis, trajectory analysis of rocket booster  
systems, familiarity with rocket engine performance characteristics  
and orbital and space flight mechanics. Assignment would be in  
booster vehicle systems, lunar and interplanetary missions and  
trajectory analysis, and development of advanced methods for  
solving all types of trajectory problems. Submit your resume to  
Professional Placement, Dept. AN-6 P.O. Box 9907, Dallas 22, Tex.

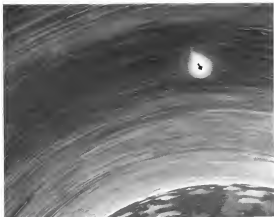
**LTV CHANCE VUGHT CORP.**  
A DIVISION OF LING-TENG-VOUGHT, INC.  
AN EQUAL OPPORTUNITY EMPLOYER

When a space vehicle slams back into the earth's atmosphere at mission's end, a curtain of silence lasting minutes closes between it and its tracking earth stations. A similar communications blackout occurs during the space firing of rocket engines. □ Villain is intense heat generated during re-entry and rocket firing which leads to ionization of atoms and disturbs or

## ELECTRONIC BLACKOUT

...AND WHAT DOUGLAS IS DOING ABOUT IT

blacks out radio frequencies. □ Because this phenomenon represents an obstacle to remote control of space vehicles, Douglas scientists are studying its exact causes. Work is in progress on methods of modulating or eliminating this interference



Analysis of radio frequency noise and absorption relative to space flight is one of more than 500 Douglas research programs now under way. Some implement and support such current Douglas projects as SKYBOLT, SATURN S-IV, ZEUS and DELTA. Others range from the study of vacuum deposited films for miniaturized electronic circuits to plans for the establishment of com- **DOUGLAS**

## BURNDY

MAKES ALL TYPES OF ELECTRICAL CONNECTORS



**Accessible, reliable, serviceable...**



**open and shut case for MS HYFEN.**

Miniature rectangular "mole" provides high density connections, and is available in 14, 20, 26, 34, 42, 50 & 75 contact sizes with leads to fit all sizes. Crimp type wing locked contacts accommodate wire sizes #18 thru #26, and are removable without disassembling connector. Hoods are aluminum alloy, swing type, draw-in design... can be opened to remove or insert contacts without being removed from connector block. Crimped connections comply with MIL-R-20000 specs with all existing solder types. Complete line of quality distribution being available. Write or call Burndy for details.

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# Thor Compact ELECTRIC DRILL



## Sensationally Small . . . this palmy of Power REVOLUTIONIZES 1/4" ELECTRIC DRILLING!

### Half the Size is only half the story

Now, a sensational break-through in electric motor design enables Thor to cut both the size and weight of the 1/4" electric drill—in half! Savings in "weight-lifting" (2 lbs less!)—savings in drill-bit life—savings in tool maintenance . . . add up to as much as 50% reduction in drilling costs! Often pays for itself in a matter of weeks! See the sensational new Thor Compact in your own office. Write, wire or phone Thor Power Tool Company, TW 2-1901 Area code 312.

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50000-1000

## We have two new r-f connectors. They are wee ones.

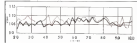
They are designed to replace N series connectors in the 1 to 10 KMC frequency range where size, weight, and low VSWR ratings are critical factors.

The larger small one is the 8RM. It represents 140 semi-rigid cable either by threading or by threading and soldering. The smaller small one is the 8RSM. It is for a 300 semi-rigid cable. Talk about low VSWR ratings. Look at their curves. The black one is for the 8RM, the red one is for the 8RSM. The maximum VSWR is less than 1.1 over the frequency range of 1 to 10 KMC. Now, about size and weight. The 8RM connector is 1/28 the

size of its N series counterpart. And it weighs 1/28 as much. The 8RSM unit is 1/32 as large as the N series connector, 1/32 as heavy. We might call them miniseries. They are.

These precision r-f environmental resistant electrical connectors are machined from brass and heavily gold plated over silver underplate. The center conductors are electrical grade Teflon. They show high performance and excellent durability.

Developed at the Research Laboratories Division at Bendix, this new series of r-f connectors has been thoroughly production designed by Scintilla Division for maximum user satisfaction. Possibly you have an application in which the use of our new r-f connectors would be advantageous. Tell us about it. Write us at Sidney, New York for technical data.



Scintilla Division





You have to, don't you, John Doe? If you don't, you have problems with high temperature magnet wire, high temperature lead wire, and radiation resistance.

John, the best solution is Hitemp's "Ceramatek." It's a nickel-clad copper conductor insulated with a ceramic-like material, firmly adhered to the conductor. Rated for continuous operation at 1000°F, or even 1190°F for short periods of time, Ceramatek is inert to solvents, oils, organic materials, thinners, and hydraulic fluids. Available in sizes 20-40 AWG, its abrasion resistance is very high, too. Useful, eh? Hitemp's Engineering Department will help us meet

special requirements using modified Ceramatek constructions. They've also got a new product—Ceramatelam—for potting and encapsulating. We oughta ask about that—I'm sending for their "Condensed Catalog" at the same time.

#### HITEMP WIRES CO. a Division of Simplot Wire & Cable Co.

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## We're putting all space under one roof at Northrop

Northrop has long been vigorously dedicated to the investigation of space, with a wide range of active programs and advanced research facilities distributed throughout its several divisions. Now all these varied space activities have been brought together under one management at Northrop Space Laboratories.

Through this realignment, each space program will be issued of getting the maximum concentration of scientific,

technical, and managerial talent. Moreover, all programs will be backed up by the experience, capabilities, and manufacturing facilities of the entire Northrop Corporation.

Northrop Space Laboratories will be located in Hawthorne, California, where new, completely equipped research facilities are now under construction.

## NORTHROP



## Practical temperature measurement from 1°K to 7000°F

|        |   |
|--------|---|
| 7666°F | ROCKET FUEL COMBUSTION RANGE<br>(Solid and<br>Autocatalytic<br>Pyrolytic)                             |
| 5000°F |   |
| 3533°F | INDUSTRIAL PROCESS RANGE<br>(Infrared<br>Radiation<br>Pyrolytic,<br>Electrolytic)                     |
| 200°F  |   |
| 564°K  | BIOLOGICAL RANGE<br>(Dried cells<br>Infrared systems,<br>radiation<br>Desiccators,<br>Freezers, etc.) |
| 0°F    |   |
| 253°K  | ENVIRONMENTAL RANGE<br>(Liquid thermal<br>systems, room-<br>temperature<br>Type 2 thermocouples)      |
| -320°F |   |
| 100°K  | CRYOGENIC RANGE<br>(Vacuum<br>radiation<br>Desiccators, etc.)   |
| -450°F |   |
| 0°K    |   |

**H**oneywell supplies workable, accurate cryogenic thermometers, filled with thermopile stems, resistance thermometers, thermocouples, and infrared Radiant Pyrometers to measure temperatures from the very bottom of the temperature scale to well beyond the conduction range of most other propellants and propellant combinations.

**FOR THE NEW WORLD OF CRYOGENICS** Today rockets, rockets, rockets, and space exploration are depending more and more on the application of cryogenics, the technology which allows us to maintain liquid and solid inerting superconductivity at extremely low temperatures. A wide range of strange and wonderful possibilities. As naturally occurring materials are used, the general trends—refrigeration, insulation, etc.—are developed to meet the needs of the cryogenic world of space. History will keep pace to apply the instruments for cryogenics and space exploration. Typical of this is the invention of the Moseley Cryogenic System, which maintains heat at 1°K to 100°K. Available in 1976, this system is a model, in practice, a relatively strong signal output that can be used to measure the temperature by means of standard power sources and a Moseley cryogenic system.

**GETTING WARMER**, the Environmental Range (200°F to 0°F) is reached here extreme cold, such as that encountered in space simulation, must be accurately measured. Beyond this is the Biological Range, a narrow band extending roughly from 0°F to 300°F within which ordinary life functions are possible. One half of these ranges

Honeywell supplies filled bulb thermal systems, resistance thermometers and thermocouples for very close measurement of temperature under widely varying conditions.

**GOING UP THE SCALE** in the practical use and measurement of heat, the Industrial Process Range is reached. This extends roughly from 500°F to 5000°F. Honeywell makes a number of standard sensors for use in this particular range (inferred Radiometric Pyrometers and many types of thermocouples, each of which has its own individual measurement range and sphere of usefulness).

**TO 7000° F.** Beyond the Sustained Pressure Range lies another which may conveniently be called the Rocket Fuel Combustion Range. In this, temperatures reach up to 7000° F. (4000° K.). Most rocket propellants and combinations of propellants have combustion temperatures below this figure, which is the upper limit of Herzog's small-tube infrared Radiometric Pyrometer.

If you are involved in the measurement of high, low, or intermediate temperatures, Honeywell can undoubtedly be of great help to you. In addition to having the world's most complete line of instruments to work from, Honeywell assumes the complete responsibility for entire instrumentation and control systems, from feasibility studies through installation and continuing maintenance. If you are doing work that involves these services, contact our Sales Engineers. Honeywell Branch Offices, Minneapolis, Honeywell, Waukegan and Winston-Anneville, Philadelphia 24, Pa. In Canada, Honeywell Controls, Ltd., Toronto, V. Ontario.

## Clearway through the weather

**all-weather** operation and automatic landing is a crucial sector of aeronautical development, in which SMITHS can claim an unequalled record of pioneer work and practical progress. Already more than 8,000 fully automatic blind landings have been accomplished, without incident, by aircraft using the Autoland system evolved on the basis of the SMITHS Autopilot. The latest outcome of SMITHS initiative is fundamental research in the Para-Visual Director. This is an entirely new concept in flight director display, which can be applied to existing instrument systems. By presenting essential information to the pilot, even as he concentrates on the runway ahead, it effectively eases his task—especially in high-speed, low-visibility landings by modern jet aircraft.

**2.16** *FFD in Pure Vector Spaces (FFD-V)* *remains not proven in the paper,*  
 in which the authors apparently incorrectly conclude only for the continuous  
 case that the  $\mathcal{F}$  is small (i.e. just a subset) and not *all* within the convex bodies,  
 namely in part 1. Also note that the  $\mathcal{F}$  is the set of the *top*  $q$  points. This  
 does not mean constant assignments, which quickly lead to the trivial  
 conclusion of the  $\mathcal{F}$  being almost entirely different for numerous from the convex  
 set. The  $\mathcal{F}$  is *clearly* less motivated by  $ELM$  and other online and quantum,  
 from just of the complex nature in High-Correlation Systems controlled in the  $\mathcal{F}$ .  
 in *Nonlinear Transfer*—the first common research is the specifically designed  
 for all nonlinear cases.

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## Hide...and Seek

On patrol in the icy Arctic night, the U. S. Navy's destroyers can now "see" supersonic enemy targets at long ranges. Their new SP-40 radar, designed and built by Lockheed Electronics now gives them greater range in grasping airborne targets.

Lockheed's reactive systems designers achieved these results with a unique pulse compression system that increases the range-to-weight ratio of shipboard radar equipment and improves its resolution as well.

Lockheed's experienced engineers engineered this sophisticated system into rugged dependable units. For example, new welding techniques provide exceptionally high strength-to-weight ratio in the antenna receiving high above the destroyer's deck.

Lockheed Electronics' engineering follow-through teams are carefully supervising installation and checkout, helping to train Navy operators and maintenance specialists, and staying with the equipment until maximum performance is achieved.

Lockheed offers these creative, practical and follow-through capabilities to the defense and civilian electronic industries alike. LEC is the electronic gateway to several thousand scientists, engineers and technicians who work for Lockheed.

**Engineers and Scientists:** For unique advancement opportunities with this talented team, please contact our Professional Placement Office, Plainfield, New Jersey.

# LOCKHEED ELECTRONICS COMPANY

PLAINFIELD, NEW JERSEY

A Division of Lockheed Aircraft Corporation

## EDITORIAL

### Reliability in Space

The premature end of the useful life of the Orbiting Solar Observatory (OSO) last week due to a malfunctioning spin control system (see p. 38) offers a good example of why the National Aeronautics and Space Administration is demanding from industry a totally new standard of reliability, or quality assurance, as the agency prefers to call it. Quality assurance is a phrase that will have a special meaning in all current and future NASA dealings with its contractors. It will also loom large in the performance records that NASA is now keeping on its contractors as a guide for its future contracting.

OSO was intended to provide a wide variety of solar data during an orbital life of six months. Instead, a relatively minor mechanical malfunction deprived the entire complex satellite of all of its useful functions at the end of 11 weeks. Another similar example of how small imperfections can cause expensive mission failures is the Ranger program. Its four Ranger shots—at a cost of about \$17 million per launch—the failure of relatively small portions of the total space vehicle system have kept this project from achieving the major goals of the program.

#### Problem Is Magnified

The problem of achieving 100% reliability in space exploration vehicles is tough enough, but the problem becomes even more acute when the space age moves on—as it will shortly—into operational satellite systems for weather reporting, navigation, reconnaissance and communications. For in these systems a single minor component failure in a single satellite could disrupt the functioning of the entire system for the interval it would take to fit a replacement vehicle into the proper orbit. This would prove to be an extremely expensive process if the failure rate matched as high as the statistical rate now generally acceptable in high quality control industries.

Because of the stringent weight limitations that space vehicles will have to live with in the foreseeable future it will be impossible to add sufficient duplication of systems to achieve the standard of perfection required for long periods in the cruel environment of space.

The elaborate structure and test facilities developed for rockets operating in the atmosphere envelope have never fully achieved a complete simulation of all the conditions of actual flight over the time periods that are significant for operational use. But they have come

much closer than it will be possible to achieve with simulators and environmental test facilities seeking a true spacecraft environment. Virtually every industrial firm and government agency in the space business is now busily creating and building a wide variety of space environmental simulators. No matter how useful these prove to be, they will still fall short in major areas of true space environmental simulation. This is perhaps the most compelling reason for developing as soon as possible large manned laboratories operating in space where the stringencies of its environment can be fully felt, measured and studied for significant periods.

#### Manned Systems Requirement

When manned space systems are considered, the 100% reliability requirement becomes even more stringent. NASA and its industrial contractors on the Mercury, Gemini and Apollo programs have reliability requirements far greater than anything yet achieved in earth-bound engineering systems, and they must be achieved in this brutally hostile environment of space.

Not only will new concepts be required, but so will new equipment and operating techniques in developing these incredibly high standards of quality control and reliability. Such a philosophy will also play an important role in basic design of space hardware. Inevitably it will produce a fallout into the entire industrial complex that will be felt in improved performance at lower cost.

The aerospace industry has always been a leader in general industry in the concepts of precision engineering and quality controlled production. It is now facing a new and even stiffer challenge to raise its already high standards to meet the requirements of space technology. NASA has hired General Electric Co. to serve as its technical adviser on how to achieve these new standards, oriented primarily toward the Apollo manned lunar landing mission. But it also will require all of the best talents available throughout the industry and other government agencies to achieve fully those goals within the time limits set by international competitors.

These new requirements of quality assurance and reliability are a hurdle that must be cleared if NASA's ambitious manned space program is to reach its immediate goals. They also present a tremendous challenge to the management and technical direction of every firm in the aerospace business, and will be a major measure of their future success.

—Robert Hays

## TOUCHDOWN ON THE FIRST PASS

A new air traffic surveillance system, Texas Instruments ASR-4, provides accurate position information on this jetliner and other traffic within 60 miles. Result: touchdown on the first pass.



Look to TI for answers to your radar problems in—

- air surveillance
- ground surveillance
- submarine detection
- missile guidance
- fire control

■ The ASR-4 is industry's answer to a Federal Aviation Agency request: "Develop a surveillance radar system to reduce field-approach congestion and minimize stack-up time at U.S. airports—make it operate reliably in all weather—continuously for 20 years."

■ Many air terminals already have the TI ASR-4. Custom modifications to this versatile radar system can be made to meet your organization's requirements.

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HUNTSVILLE, ALABAMA  
AND CHICAGO, ILLINOIS



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## WHO'S WHERE

### In the Front Office

**R. Douglas Lasser**, president, Chrysler Corp. V. Bruce Dorman, New Orleans, La., secretary. **J. C. Smith, Jr.**, manager. **William R. Ross**, president, Ede Corp., College Point, N.Y., secretary. **Paul B. McKinnon**, new board chairman, McMillan, secretary. **Earl Dodge Oliver**, secretary. **Mr. Oliver** will continue as a director emeritus and a member of the administrative committee.

**Group Capt. E. Finney**, a director of Drexel, Ltd., London, England. **Group Capt. Finney** is outgoing director of Drexel, Ltd., and a director of the newly formed British Space Development Co.

**R. Donald Gorman**, vice president general counsel, American Republics Assurance Corp., Garden City, N.Y. **Willard L. Lasser**, secretary. **Mr. Gorman** is vice president and director emeritus of the American Republics Assurance Corp.

**John R. Wicks**, vice president of Boer Allen Applied Research, Inc., Bethesda, Md. **Edward G. Hether**, vice president and assistant to the president of Aerovision, a division of North American Aviation, Inc., Downey, Calif.

**Robert M. Freeman**, a vice president, General Personnel Laboratory, Downey, California, Calif.

**Sam C. Polansky**, vice president marketing, TDS Division of Amphenol Corp., Elmont, N.Y. **Charles G. Dasher**, Group Research M. Smith, vice president market research, Consolidated Electronics Corp., Pasadena, Calif., subsidiary of Bell & Howell Co.

**Frank U. Glass**, vice president general manager Instrument Corporation of America, Milwaukee, Wis. **James C. Brown**, secretary. **Mr. Glass** is vice president and director of the Research & Analysis Division.

**George V. Boudreau**, vice president operations, Eumec Metallurgical Corp., North Chicago, Ill., and Ralph W. Ransom, vice president and general manager, Eumec Metallurgical Corp., North Chicago, Ill.

**Titus Arnold** has announced the appointment of the following regional vice presidents: **E. Paul Baker**, Atlantic Region (New York); **V. E. Swift**, Pacific Region (San Francisco); **E. W. Jacobson**, Central Region (Kansas City).

**Jack P. Shover**, a vice president. The 7th National Co. Chicago, Ill. and general manager of the Canadian Division.

**Robert King**, vice president public relations, Continental Air Lines and **John R. Koway**, assistant vice president flight services.

**Donald A. B. McIntosh**, vice president and director of operations, Dornier Electronics, Ltd., Downey, California. **Donald McIntosh**, vice president operations, Northland Aircraft, Ltd.

**Col. Richard H. Carter** (USAF, ret.) director of the Missile and Space Council of the Aerospace Industries Association. **Mr. Carter** is a former director of the General Wing and Electronics, Ministry of Aviation, London, England.

(Continued on page 124)

## INDUSTRY OBSERVER

■ Left dog out of the parallelogram: to be used in landing the Gemini two-man spacecraft will be 1:2, between that of the Pioneer parallelogram launch vehicle now flying at NASA's Flight Research Center, which has a ratio of 1:4, and the North American X-15, with a ratio of 1:5. The parallelogram will give Gemini a capability of maneuvering to shift its landing point by 25 in downrange and 15 in uprange.

■ Determination of the requirements of the VAX class-support aircraft is meeting a final decision on the F-111A (F-11) in subsonic tactical aircraft. However, several companies are known to be conducting proposals embodying both conventional takeoff and landing and VTOL characteristics.

■ Apollo orbital problem simulation is about to begin on the five-degree altitudes simulator at NASA Ames Research Center. The combination can follow, elevation and azimuthal rotation has just completed a series of repetitive transport control studies.

■ Glass-wound pressure vessels equal in size to those of current jet engines could be fabricated in a new glass-winding facility being constructed for United Technology Corp., according to a UTC study. This technique of manufacturing pressure vessels has never been used on anything larger than a small propellant rocket case, but UTC says it has modified its application to structures up to the size of a submarine hull.

■ Feasibility of a thrust-modulated, restartable solid propellant rocket is now being demonstrated by Aerojet-General Corp. A number of these rocket motors have been fired successfully.

■ Thirded first stage of the Minuteman solid propellant intercontinental ballistic missile carries 47,000 lb. of ammonium perchlorate mixed with 17% of powdered aluminum. In adding the oxidant to the base material there is a highly critical period of 12 sec. in curing of the highly volatile combination. Specific curing of the mixture is 140.

■ Aerojet-General Corp. is about to make a comparative test of solid jet propellant and nitrogen tetroxide as liquid oxidant thrust vector control fluids in a single two-minute firing of a seven-segment solid propellant rocket developing 700,000 lb. thrust. During the same test, a Titan 2 engine will be mounted separately above the solid motor to simulate vibration conditions of the USAF Space Shuttle. Space Shuttle launch is currently scheduled 5 AM May 25 p.m. 20. Fluids will be pumped through the Titan plumbing during the test.

■ Use of white cockpit and instrument lighting in place of red is spreading and both Federal Aviation Agency and Air Force representatives reacted favorably to the system in the Lockheed C-141 jet cargo transport at a recent week-end review. Air Force has introduced the system into the Northrop T-38 jet trainer and the Lockheed C-130.

■ Army Transportation Research Command plans to award one or more contracts for operational studies of the use of ground effect machines in support of Army's off-road logistics mission.

■ Air Force Ballistic Systems Division will issue RFP for industry proposals for development and production of integrated high-frequency radio systems for use in high-level nuclear weapon systems. Deliveries of first production units is to be within approximately one year.

■ Engineers' approach to reconnaissance which has been ordered by Secretary of Defense Robert S. McNamara will combine all military intelligence gathering requirements into one package. Regardless of the type of system, electronic, infrared, photographic or "synthetic", they will all be integrated in the same, never needs with non-duplicative effect. Studies will be completed Feb. 15.

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## Washington Roundup

### Anti-Secrecy Campaign

House Government Information Subcommittee has launched its campaign to force the Defense Department to issue a declassified version of the directive classifying military space activities in secrecy (AW May 28, p. 25).

Subcommittee Chairman John Mica, in a letter to Defense Secretary Robert S. McNamara said that Under Secretary of the Air Force Joseph Church, chief author of the directive, has "indicated that the directive is questionable which is precisely classified could easily be declassified by means of a declassification review."

Rep. Mica contends that classifying the directive has caused widespread confusion about its intent. "Experts who have studied the history of secrecy and censorship of defense information in the U.S. have found that the government's secrecy efforts in the field have been successful only when the fact of censorship has not itself been revealed," Rep. Mica told McNamara.

Subcommittee staff members recently discussed the directive with Church. In his letter, Rep. Mica urged McNamara "to take the steps necessary" to provide a declassified version. Subcommittee hearings on the space secrecy policy will be the next step.

An F-111A (Korean Air Force T-111) tactical fighter program has encountered still another delay (AW May 28, p. 25). Defense has directed the Aeronautical Systems Division at Wright-Patterson AFB to review the performance requirements to determine if they can be improved to enable Air Force operations. Review probably will delay the contract award, originally expected this month, until July.

### Space Use for Fluorine

Possible use of fluorine as fuel for early space vehicles in Centaur will be explored soon as a House space subcommittee hearing being held by several industry leaders as an outgrowth of congressional interest in the chemical.

House hearing, to be chaired by Rep. Joseph Keith and tentatively scheduled for June 18, coincides with Senate space committee consideration this week of the National Aeronautics and Space Administration Fiscal 1965 budget. The budget authorization bill, as sent to the Senate by the House, provides \$500,000 for work on high-energy fuels such as fluorine and boron combinations.

Rep. James Poff of Pittsburgh, would make Republicans on the House space committee, sponsored the high-energy fuels committee. He is trying to persuade Chairman Robert Kerr of the Senate space committee to double the \$500,000 authorization. Projects for this action are highlighted by the fact that Caltech Chemical Co., a producer of high-energy fuels and oxidizers, has facilities in California-San Kern state as well as in Pennsylvania.

Bell Aerospace Co. has been working for several years on engines using a liquid fluorine-hydrogen combination with thrust levels reportedly as high as 35,000 lb. Bell is a possible winner for the House hearings. Rep. Keith opposes the hearing with the hope, but certainly not the conviction, that fluorine eventually can be used in Centaur to improve its performance.

### RS-70 Funding Status

Question of how much money Congress should appropriate for the reconnaissance satellite version of the RS-70 bomber is headed for a House-Senate conference. Senate Appropriations Defense Subcommittee has not yet voted along with the Air Force and recommended \$40 million for Fiscal 1965 to develop an aircraft, rather than the programed three. House-passed bill would appropriate \$125.0 million for the program—\$12.6 million more than the \$112 million President Kennedy requested (AW Apr. 25, p. 15).

Senate must likely will adopt its subcommittee's recommendations. Resulting House-Senate conference may split the money difference in this bill. But how much Defense will spend on the RS-70 is still an open question. The Senate bill of the RS-70 version McNamara ordered still is being studied by Air Force Under Secretary Church.

### Comsat Foes' Strategy

Senate opposition of the House-passed bill to establish a private corporation to operate a communications satellite system already are employing delaying tactics in hopes of killing the measure. They would until June 1, the deadline day, to file their minority report and are heavily expending a filibuster.

Meanwhile, Federal Communications Commission Chairman Newton Minow privately is expressing fears that the Kennedy Administration will be blamed when public-bought communications satellite negotiations stall, look to yield demands for the first few years.

Sign on wall of Marshall Space Flight Center's Future Projects Office, whose personnel would manage development of the giant Navy space booster if the non-developed project ever gets under way. "Navy-Navy report suddenly at unexpected terms and prices, in some cases becoming the brightest object for a few days. They then fade away and disappear!"

—Washington Staff





# House Unit May Urge Restriction Of DOD Chief's Unifying Authority

By George C. Wilson

Washington—House Armed Services special subcommittee may recommend that Congress restrict the authority of Defense Secretary Robert S. McNamara and in establishing such centralized bodies as the Defense Intelligence Agency and Defense Intelligence Subcommittee, Chairman Patrick Leahy, D- (D-Vt.) told Associates. When that testimony given so far in his job as Defense agency "poorly establishes the fact that the Secretary of Defense can do just about anything he wants to do except the extreme language," Rep. Leahy and other subcommittee members said the Defense Secretary should not be authorized to order the service.

Although the view was challenged by McNamara during hearings last week, the subcommittee may well seek to limit authority added to the National Security Act. The chairman of such actions being moved depends largely on how Chairman Carl Albert (D-Ga.) of the full committee reacts to the subcommittee's recommendations. Rep. Viscusi is withholding judgment until the end of the hearings.

The language in committee, as contained in sections 2321(a) of the Na-

tional Security Act, known as the McCormack amendment. It states: "Whenever the Secretary of Defense determines it will be advantageous to the government in the area of efficiency, economy or efficiency, he shall provide for the carrying out of any supply or service activity common to more than one military department by a single agency, or such other organizational entities as he deems appropriate. For the purposes of this paragraph, any supply or service activity common to more than one military department is hereby defined as a 'major common function'."

## 'Escape Clause'

Rep. Leahy and the Defense Secretary said the language is "a simple escape clause" for military departments rather than just establishing one organization to obtain supplies used by all the services. McNamara told reporters during his visit that such actions are "absolutely impossible," adding that he had no intention of using the service.

McNamara and his intent in establishing such central bodies as the Defense Supply Agency, to promote economy and efficiency as dictated by Congress. He said he need to secure the

## Nuclear Test Falls

Washington—The booster carrying a live nuclear warhead was destroyed by a stage safety officer June 4 when it fell into the ocean after launch from Johnston Island, the Pacific Ocean testing area. It had been planned to demolish the device at an altitude of 10 to 15 miles.

The missile was destroyed 100 sec. before its scheduled time to explode. The chairman of the Test and Evaluation Committee, which led into the nuclear device, which fell into the sea within the designated test area, the Atomic Energy Commission said.

Unplanned and predicted additional savings in continuing military tests. It is (DASA) director (see money) and weapons," McNamara said, "then I'll try it as a model."

Although the subcommittee is considering the DSA, it also is investigating the Defense Supply Agency, Defense Communications Agency, Defense Intelligence Agency and National Security Agency. Rep. Leahy and others are also expected to analyze the potential for these defense agencies and the potential for these agencies, electronic how the agencies affect the overall effectiveness of the armed forces, and to consider the extent these agencies have absorbed the functions formerly performed in military departments.

McNamara said the subcommittee has "no plan to say yes" toward the establishment of another central agency. This was in answer to whether he planned to study such independent activities as the Military Air Transport Service.

A House government operations subcommittee recently held hearings on the DSA and is currently writing a report on its findings. Leonard T. Johnson, associate director of the General Accounting Office defense accounting division, and GAO's study of DSA and the Defense Claims and the Terrestrial Supply Center indicated that had been some "limited standardization directions" but that "in the main the actions to date have been administrative in nature with no real attempt of the objective generally contemplated on reducing the same types of problems as heretofore. Accomplishment of real standardization in many instances is still being made dependent upon strategy, development of new prototypes or capable items, and approval by the services concerned."

"It thus appears," Johnson said, "that the services are still doing substantial adjustments as they have to live with through it is directed by the director, DSA, as behalf of the Secretary of Defense."

# NASA, DOD Adopt Standard PERT Form

By Philip J. Kline

Washington—Standardized procedures for the PERT/Cont system developed to provide management with data for improved planning and control of tasks in large defense and space programs, has been adopted by the Defense Department and the National Aeronautics and Space Administration.

The new standard is an adaptation of the original Navy developed Program Evaluation Review Technique (PERT) in which cost estimates are attached in addition to the lowest time estimates (AW No. 25, 1969 p. 15). The original is now referred to as PERT/Time, in distinction to PERT/Cont.

When used in connection with time as a common framework, it enables management to appraise progress of a program more accurately and to assess better the overall effects of alternative means of action.

One objective of the new standard is to eliminate the many different versions of PERT/Cont that have come into use in recent months, thereby saving the industry which would result of each service adopted a slightly different procedure. Thomas Merritt, assistant secretary of defense for production and installations, headed a committee study which will attempt to develop a single standard.

Present plans call for each of the military services to try out the new standard on several ongoing programs which will serve as pilot projects.

A handbook which outlines the principles of PERT/Cont, procedures for putting the system into operation, standard data reporting forms and the type of supporting procedures to be used is now being drafted by the Defense Department in joint cooperation with the individual services, probably within 15 days. Larger quantities will be available to all through the Government Printing Office.

## PERT/Cont Details

In contrast to PERT/Time, in which time estimates are obtained for the most likely "upstream" and "per se" items" (used together to accomplish the activity), the new PERT/Cont system will use only a "most likely" estimate. Another major difference is that each cost estimate is required only for a group of selected activities, rather than for each individual activity.

The new standard is an outgrowth of a PERT/Cont study initiated by Navy Special Projects Office in January, 1965, with the Massachusetts Systems Corp., Cambridge, Mass. The company was headed by Dr. J. Irving Livingston, Davis-Brown School professor who served as a consultant to the Defense Department in setting up the recently formed Logistics Management Institute.

After six months of study, two possible approaches to PERT/Cont were devised. The approach required a cost estimate for every activity, while the other required only the cost estimates for a group of selected activities.

The two approaches were evaluated in pilot tests, begun last summer at General Electric's Defense Department on a fleet ballistic missile tracking facility under development there, and at Lockheed's Missile and Space Co., using the Polaris A-3 missile itself as the subject. The latter approach was found easier than the other while the Lockheed study was in July.

## Company Experience

Experience at both companies indicated that the estimated activity costs could not be obtained with sufficient accuracy to match the added work burden imposed on operating personnel.

During the past year other military services and agencies have been experimenting with different PERT/Cont procedures, to have several major cost centers. Recognizing the burden on industry which would result of each service adopted a slightly different procedure, Thomas Merritt, assistant secretary of defense for production and installations, headed a committee study which will attempt to develop a single standard.

The committee, headed by James N. Dixon, deputy assistant secretary of the staff for production management, is now preparing a report to the Air Force, Army, Navy, Defense Department, NASA and the Budget Bureau.

The procedures developed by Navy Special Projects Office and Management Systems Corp., which he finds to be the most basic, served as a starting point. After agreement was reached among the government agencies and services, Dixon called in a number of major defense and space contractors to go over the plan and get their reactions.

Industry reaction has been extremely favorable to the idea of a single standard procedure. Dixon told Associates. When, recently, the standard handbook of procedures was submitted to Defense Secretary Robert S. McNamara, who has approved the final standard. Recognizing the increased work load imposed by PERT/Cont, Dixon says the committee has attempted to simplify procedures and minimize delay.

Because PERT techniques are so easy, benefits to corporate management is in government contracting agencies. Davis believes that industry will adopt the new cost procedure voluntarily, at least as a trial run. Defense does not expect to use PERT/Cont now.

Many on all new programs, but within several years Dixon expects it to be used on all major defense programs.

Other developments in PERT techniques are evolutionary, pointing to similar program concepts which have previously been used in a number of instances. But he believes the PERT format is considerably evolving "because it forces engineers to plan, in detail and it enables management to control programs."

Where formerly company management often did not worry about meeting a delivery date until the contract was in hand, "today it is not unusual to hear a heated discussion over whether a delivery date 10 months away will be met," he says.

Although considerable effort already has gone into the preparation of the new PERT/Cont handbook, Dixon expects that industry experience will suggest possible changes, which he says Defense will encourage.

## Japanese Transistor Imports to Continue

Washington—Electronic Industries Assn. petition to Office of Civil and Defense Mobilization to restrict imports of Japanese transistors because they already pose a threat to national defense has been turned down by Edward A. McCormick, director of the Office of Emergency Planning. His action, based on studies by the Defense and Defense Department, was preceded by Assistant Warfare since a secret report (AW No. 16, 1965 p. 13).

McCormick cited Commerce Department figures showing that Japanese transistor exports to the U.S. amounted to less than 2% of U.S. production, and the bulk of these entered as components of Japanese ball valves. In addition, Japan has contributed no better quality premium transistors and only to consumer products and has been not competing for the defense equipment market, he said.

Recent Commerce Department figures show that silicon transistors, widely used for defense applications, represented only 0.2% of the total semiconductor production in 1963 by the Japanese.

The Defense study reported that the U.S. semiconductor industry is "large and growing" and has enough reserve capacity to meet any sudden increase in demand," McCormick's decision said.

During the two-year period that the EIA petition has been under study, domestic semiconductor industry sales have increased by 125% and the rate of Japanese competition, the figures indicate.

## SAAC 23 Facilities Set for Wichita

Wichita, Kan. is establishing facilities in Wichita, Kan., to handle marketing and assembly of its aircraft engine to SAAC 23 executive transport (AW No. 25, p. 31).

Under plan, the General Aircraft Co. will provide new manufacturing system in the region by increasing capacity. Second phase will build the business plane under the name of the Wichita company, including Robert Claffey, former General Aircraft and sales promotion director, who will be in charge of production, and Henry Winters, former chief engineer in General's Military Aircraft Division.

Plans to begin operations in Wichita within 10-15 days and is scheduled to produce about 1,750-2,000 people in first year.

Current thinking is that Wichita production of the SAAC 21 will be in six-eight weeks monthly, and indications are that the plant will be reporting full production in Europe at output levels up to the U.S. Section close to the project up to that time has been dominated by the low part of the European operation. He believes that although production in this country may not come due to higher labor and overhead charges, some efficient production may well exist up to the defense. Last a report to come from a new company to handle the Wichita operation.

A General spokesman said that discussions between General and General Aircraft Division. Winters indicated the possibility of offering General Aircraft division work for marketing the new jet.

A full-scale, completely furnished meeting of the SAAC 23 was scheduled last at its first U.S. showing at the 18th Maintenance and Operations Meeting at Rendon, Tex., November 1964.

The SAAC 23 was shown to the 12,718th General Electric CJ450-D personnel in place of the 1,400th GE CJ450-D engine shown planned order in order to handle some increase in the engine's weight. Prior to a new being set at 1,400 lbs fully equipped with electronics and complexity increased.





**JACKING OPERATION** In loading cargo is demonstrated by the Sikorsky S-64 Skycrane. How hydraulic fluid has been pumped out of the main landing gear cylinders, leaving the helicopter 8 in. in attachment of the jacking landing gear of drive.



**PALLET SECURED.** Fuel is pumped back into the gear cylinders. The pallet now is clear of the ground, permitting the loaded S-64 to taxi or to make a running takeoff. Right-hand wheel of the gear also can become a cargo slingshot device in load hauling through rotation of a hydraulic line. Backlike structure behind cockpit houses test instrumentation.



**UNLOADING OF THE PALLET** is reverse of the jacking operation. How the pallet is being towed away with the S-64 still in the "down" position. Second S-64, with tank trailer load attached, is in background. It is one of two for West Germany.



**ANTENNA** In experimental radio altimeter AFN-147 manufactured by Electrolytic Avionics Corp. extends below nose of the S-64 (right). Designed to give the crew operator a greater indication of how much cable is pay out, the device is sensitive to 25 ft. Under this system will have antenna extended to virtual flash mounting. Plastic caps on landing gear strut (left) are utilized for testing by electric fluid levels. Gear travels 5 in. in jacking operation.

## Skycrane Demonstrates Lift Capabilities

By William H. Gregory

**Stanford, Conn.**—Sikorsky Aircraft Corp. formally unveiled its twin turbine S-64 Skycrane to potential civil and military contractors last week, demonstrating both single- and two-cable hoists, as well as climb-low altitude fly-by and landing.

The demonstration helicopter, which had flown a total of 3 hr prior to the display, is Sikorsky's own aircraft. A second S-64, due for delivery to West Germany in December, was on static display. Sikorsky is building one more S-64, also ordered by the Germans for delivery next year (AW Dec 25 p. 18).

Sikorsky plans a 60-hr flight test program that will require the test of this test to complete, and the West Germans are planning a 72-hr program. The German helicopter also will be evaluated by France and Italy.

U. S. Army interest is apparent, and an order for three S-64s may be placed with Ford 1965 funds. Lt. S. Johnson, Sikorsky general manager, said that Department of Defense had shown interest in the concept but had assigned priorities for levels in other types and uses of helicopters.

Unit cost of the S-64 was reported by Johnson at approximately \$1 million, but possibly dropping to \$1 million in greater production.

West Germany has indicated it was most to move into the 10-ton payload category—the Russian 11-ton during course has set a 16.5-ton weight lifting record—rather than the 10-ton category of the

S-64. But Sikorsky is preparing to plug two S-64s to perform the same mission to avoid the relatively long de-choicement time to move into higher weight class. Coupled load carrying could be accomplished by attachment of a light spreader bar to the load and extension of a bar at each end to each of the helicopters.

Development of a 55-passenger pod for the S-64 is under way and will be used by military. Passengers will be seated on aircraft three on either side of a center aisle and the pod, essentially fixed into the basic crane, will be suspended on hydraulic pistons to exit clearance.

No Federal Aviation Agency certification program is planned currently, and civil applications are expected to be in military and government programs. Some of those proposed include anti-submarine and only one marine as a rescue lifeline in limited use and as a rescue vehicle for large space boats.

As a commercial passenger vehicle, the S-64 would have direct operating costs of \$4-45 cents per seat mile on 114,000-lb. stage lengths or in range across coast of 15-40 cents a mile.

One civil application Sikorsky is in developing now is logging, and a demo was will be made by Feb. 1, 1967. Sikorsky and the U. S. Forestry Service cooperation will demonstrate the S-64 in actual logging operations in West Coast timberlands late this year.

Cost of load handling into timber lands has risen greatly and method logging is faster because loading

times. That contractors and the Forest Service are studying helicopter capabilities. Problems to be solved prior to any S-64 demonstration this year, besides state of the test program, include what type of mounted hoist will be necessary for logging and how the cost of the demonstration would compare with costs that actually would go to the buyer.

Besides the flight test team, static test stand operations of the dynamic components of the S-64 are approaching the 700-hr mark. Walter W. Lissak, senior project engineer on the S-64 and the engineer on the stand has developed close to 60,000 lb. stress, including an efficient test system.

Operation of the Pratt & Whitney JT12D-15 generators rated at 4,000 hp, however, has been without difficulty except for a problem in adjustment of oil pressure, Lissak said.

In previous tests, or at the design stresses, the S-64 has performed satisfactorily, climbed at 3,000 ft/min and reached a forward speed of 110-120 kt (indicated). Single engine losses was demonstrated at a gross weight of 24,000 lb. Minimum single engine hover capability is 13,800 lb.

Test instrumentation is mounted in box-like structure behind the cockpit. It includes air speed logs and a photo panel comprising 120 instruments for measuring thrust, powerplant performance, stability and control etc. Most instrumentation is concentrated on the dynamic components.

## U.S.-Funded Military Research Abroad Will Be Unified by DOD

Washington—Defense Department is planning to unify all basic research sponsored by the U.S. military across outside the U.S. First move was to reorganize last week with the announcement that a Defense Research Office will be opened July 1 in Rio de Janeiro, Brazil.

Although a Defense official denied that there was any immediate plan to further coordinate research in foreign universities and laboratories supported by U.S. defense funds, American Warrents issued that separate European offices of the Air Force, Navy and Army will now be ordered to report to a joint office in Paris, which is now will be responsible to Dr. Harold Brown, Director of Defense Research and Engineering.

The new South American office will coordinate the military research program throughout Latin America by conducting work sessions for technical basic research. It will also manage the exchange of information and work of U.S. and Latin American scientists with area test research interests.

Initially, the contracts are expected to amount to \$100,000. In another year the expenditures are planned to reach \$1 million.

### POSS Details

Washington—Additional details on the new Foreign Military Research Office (FMRO), to be developed by Radio Corp. of America for USAF's Electronic Systems Division, have been released by the Air Force with the announcement of a \$2.5 million contract award to the company.

The system, expected to have a major role in that of radar against such targets as the use of satellite and spot vehicles, will employ a high-power wide-angle telescope, an extremely sensitive image detector tube with a mosaic of photoconductive cells and data processing equipment for storage and analysis of the raw video recordings.

Images of targets, which remain fixed in space, will be recorded not automatically to permit rapid detection of any moving object, a function as critical. The image will be stored in a memory that it would be made if the telescope were aimed at the target. Automatic controls will prevent the telescope from viewing the area in question. This prototype system, which is being developed in 1966, will be modified on a computer to give Navy Means for evidence tests.

There are the European offices which will be affected:

- **European Office of Aerospace Research, Brussels, Belgium**, which reports to the Air Force Office of American Research. Commanding officer is Col Paul F. Noy. About 95% of the funds of this office go into basic research and 5% into applied research.

- **Office of Naval Research, French Office, London**, under command of Capt John K. Stansbury.

- **U.S. Army Research and Development, London, England**, under command of Col Charles O'Brien.

Present annual expenditures of these offices is: Air Force, \$6 million; Navy, \$1 million; Army, \$1 million.

Under the new plan, which will begin with each of the offices reporting to James M. Conner, director of the research and development division, U.S. Department of Defense representative for the North Atlantic and Mediterranean Area North Atlantic Treaty Organization.

Conner, who already is coordinating work of the research and development of the U.S. and NATO countries, will add the basic research activities of these services to his responsibilities. He is responsible to Dr. Brown.

The new Air Force office will be sponsored by the Army, which has been designated as the executive agent of the Defense Department. Col Leonard M. O'Brien will head the office and its Army liaison. Lt. Col Charles I. Lyons will head the Air Force element.

The National Science Foundation and the National Institutes of Health will open offices in the new building in Rio de Janeiro. Each of these offices will be responsible to its own agency, but the combined activities will be coordinated by the State Department. The State Department coordinator will be a senior official, not yet assigned.

Defense officials said that although the scientific office in Latin America is not in place as in Europe, there are sufficient high quality scientific facilities to warrant establishment of the office. The move will result to some extent which has universities and research laboratories. Engineers have been noticed that spend research will be conducted in the countries where they are located.

It was indicated that eventually an office would be opened in Japan to take advantage of scientific talent there. It was denied that the office would be so at present. A study is being conducted to see how much talent is available in Southeast Asia.

### C-141 Engine Tests

Port & Military Division of United Aircraft Corp. will mount two TF350 7 turbojet engines, scheduled to be completed for the USAF/Lockheed C-141. The latter transport has a 160,000 lb thrust engine is expected by January 1967, according to USAF.

The C-141 engines will incorporate structural and low drag (AW) (see p. 18) and are being designed for the compressor blades in the front.

## X-15 Fails to Achieve Programed Altitude

Los Angeles—Planned peak altitude of 162,000 ft. was missed by 15,000 ft. in a flight by North American's X-15. The X-15's climb, the stability of the experimental aircraft at a higher angle of attack than it had yet achieved.

Failure to reach planned altitude occurred because a bad failure of telemetry made it impossible to ground personnel to warn Test Pilot Mike Robert White that his control stick angle was a few degrees lower than the correct climb-out path of 38 deg.

During time of the X-15's 99 solid engine was 91 sec. instead of the planned 93 sec. This contributed to the failure of the X-15 to reach its planned altitude. At the planned climb angle, the 57,000-lb thrust engine is scheduled to accelerate the airplane at about 100 gph. per sec., to increase velocity should have been about 250 gph. more than the 3,700 gph. recorded.

White said he obtained an angle of attack of about 21 deg. shortly after launch at an altitude of 55,000 ft. and was expected to 2g during the ascent. The precise moment angle of attack will not be known until data tapes are analyzed. The highest previous angle of attack during the 15 sec. NAA's flight research contract was 15 deg. The X-15 is gradually increasing angle to a maximum of about 25 deg.

The full channel of stability stability augmentation system, also a critical necessity, was down during the flight.

Launch from the Boeing B-52 carrier plane was at an altitude of 45,000 ft. over Delaware Bay Lake 56 on north of San Vito. The X-15 was launched on the flight to the Dry Lake landing site at Edwards AFB, Calif., at 2:05 p.m. Duration of the flight was 11 min. as permitted by the flight plan. The aircraft was in Mach number was 3.15. An observation on the aircraft failed during the flight but a backup net prevented any difficulties.



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## THEY WATCHED THE FIRST DOG FIGHT

LEACH HERITAGE OF THE AIR — 80

First the French soldiers, then the Germans, climbed out of their trenches to stare up at a novel new world sight. On this morning of October 3, 1914, they watched two airplanes in mortal combat—the first dogfight in the history of aerial warfare.

The French craft, a Voisin bombing plane, was recovering from a mission. Stung five hundred feet over the village of Imbatten, near Belgium, Sergeant Joseph Frantz spotted a German Albatross far below him. It was heading East toward enemy lines.

With a nod to Corporal Quesselt, his observer and machine gun-

ner, Frantz banked into a steep dive, cut off the German's flight path, and forced him to turn back. Then the shooting started. Quesselt began firing point blank at the winged Albatross. But because his Hotchkiss machine gun was at the rear-swinging type and often jammed, he could only get off one shot at a time. From the beginning, the Voisin had the advantage. Its machine gun was mounted in front of the pusher engine, so it could lead straight ahead at its enemy. But—since synchronized firing through the propeller was not yet developed, the Albatross could

fly only to the sides and to the rear above its tail.

The German pilot, Sergeant Willy Schlichting, tried desperately to twist and turn out of Quesselt's range. But Frantz kept his Voisin right behind the Albatross's tail. And round after round went into the German's fuselage. By now, this dogfight was a mere 600 feet above the rolling French hills.

All this time, French soldiers, covered with the mud of the trenches, cheered on their countrymen. Quesselt had responded with a total of 57 rounds—most of them hits. Then, all of a sudden, the Hotchkiss jammed. It looked like the war's first dogfight had ended. But seconds later, the Albatross flipped upside down, spurted out a cloud of burning gasoline, flamed and dropped like a dead weight straight into the ground.

In less than 20 minutes, the war's first dogfight was over. And a whole new chapter in aerial warfare had begun.

Joseph Frantz was decorated with the Knight's Cross of the Legion of Honor, and Quesselt was awarded the Military Medal. (Throughout World War I, the pilot of a two-seater aircraft nearly always got the higher honor even when his observer made the kill.)

Joseph Frantz learned to fly in 1905, when he was 20 years old. He became France's 365th licensed pilot in February, 1911 and set a world record for sustained flight (4 hours, 27 minutes) in a two-passenger plane. He joined the French Air Service in 1912. He was a member of Squadron 54 at the time of his heroic exploit.

The plane he was flying on that fateful October morning also held a sustained flight record. The Voisin could travel at 50-60 feet per five hours.

It was powered by a 135 hp. Sabatier pusher engine mounted between the wings and facing the rear. Machine guns were slung high to keep spent cartridges from flying back into the propeller blades. Both Frantz and Quesselt are still alive today in France. Frantz lives in a small Paris apartment, and still flies about 150 hours a year. Without a machine gun.

### Heritage of the Air

One of the most inspiring chapters in the history of technological evolution is the story of the men and flying machines of World War I. It is the highly personal story of brave men—and the wind, wire, keen and rudimentary technologies that sustained man's desire to conquer the sky. Leach Corporation celebrates 40th year in chronicles with the presentation of this Heritage of the Air series.

★ ★ ★

*Technical Director for Heritage of the Air is Lt. Col. Kimberlough S. Brown, USAF.*



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sons and it will never to return as a B-747. The first time it landed in New York light would be identified as B-747-400 and not as a B-747-400. The B-747-400 would be identified as the B-747-400. If the light comes from New York, to the West Coast or into the Pacific area, however, that segment would remain B-747-400's original name.

B-747-400 will also be able to be identified by its tail number, as well as its origin (with B-747-400 and B-747-400). B-747-400 will also be able to be identified by its tail number, as well as its origin (with B-747-400 and B-747-400).

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## Anti-Carroll Forces Swing ALPA Election

By David H. Hoffman

Maersk-Busch-Don't have, candidate Charles Rule of National Airlines, with the sudden support of even pilot who opposed John Carroll as president at the time, has won the election.

Rule, pilot of the airline's 747-400, was elected to the office of president of the union's 11,000 members.

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"Cathairon," flight among London, Bermuda, Miami and Jamaica with a connection to Miami.

Comair flight 707 flight and other airlines have been given the option of transferring to B-747, if they wish, to maintain operations with the jet.

B-747 will continue maintenance of the two B-747-400, boosting its replacement from 16 to 18 aircraft, an increase of about 12% in maintenance work. Since the flight will continue at Comair flight's maintenance center at London Airport, the two companies propose to shift maintenance maintenance services for B-747-400 and B-747-400 to the Comair facility.

Officers of B-747 and Comair will meet last week with the flight and maintenance trade union to

explore the creation of B-747-400, Ltd. and other the current approval of work transfer. No labor problem is anticipated, a B-747-400 spokesman said, because that company and Comair flight's Airline have shared identical values since the jet's arrival.

Other terms of the agreement to form the new company, which will have its registered office at London Airport, include:

• W-100 and Super W-100 jet transport will eventually supplement B-747-400 in the B-747-400-Comair transportation service.

• Fixed seats to B-747-400 will be set at 150, the same as B-747-400.

• B-747-400 will be entitled to make full use of B-747-400 and Comair's cargo and advertising space on presentation of the new member's aircraft.

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### Trunkline Pilot Vote

| Aircraft     | For   | Against |
|--------------|-------|---------|
| Boeing       | 402   | 1,294   |
| Capital      | 262   | 0       |
| Continental  | 789   | 0       |
| Delta        | 451   | 0       |
| Eastern      | 256   | 1,360   |
| National     | 220   | 0       |
| Northwest    | 0     | 251     |
| Southwest    | 400   | 0       |
| TWA World    | 0     | 1,291   |
| United       | 1,291 | 334     |
| Western      | 30    | 222     |
| Var American | 410   | 611     |
|              | 4,013 | 5,204   |

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later opposed Carroll also opposed the early election. The count, 5,685 for, 5,784 against.

At the election got under way June 3, 1st of a complicated series of results from the floor was made to make McDonnell eligible to run for president.

McDonnell, a United pilot, McDonnell had resigned from the union to operate business before his return as executive administrator and it was said that only a two-thirds majority of the membership could send him a place on the ballot.

McDonnell's opponent was brought to a sudden end by a roll call vote in which 6,079 pilots backed his candidacy but 6,007 opposed.

Carroll's victory, however, United pilots voted in a 30-min. session that American and TWA delegates used a vote of no confidence and points of order to stall the election.

After the election, the vote Carroll's name was placed before the delegates by the remaining committee and announced Carroll and Rule followed.

As delegates they were elected to the union's executive committee, the members of the union, the strategy of the anti-Carroll forces came into focus. First, there was an announcement that McDonnell endorsed Rule as the new executive administrator.

Rule was elected. Then Carroll addressed the assembly.

"Disruptive force" at work within the union had prompted his speech.

## French Alter 707 Takeoff Checks

Paris-Air France instructed pilots last week to adopt new manual testing techniques during and prior to takeoff.

The new technique, however, the airline said, is a change of 707-320 (test) procedure at Gite Airport lifting 110 tons.

A telegram from the director of flying operations, to all pilots and airports, said that the airline member a report of 115,194 lb, without leaving the ground and that an unusual arrival situation was being developed as a result.

It is possible the director left pending in an extreme case down position.

The telegram instructed pilots to follow three trial-of-procedure.

• After testing manual testing, check that there is no load on the ground.

• Up to 100 lb, on takeoff, the copilot is to push the control column forward to a position between 100 and 120 lb.

• At 100 lb, pilot alone takes over climb and should feel progressive resistance as he moves the control column up.

• If no such resistance is felt at 100 lb, the pilot will be shorted.

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CHARLES RULE



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## Pilots Take Tougher Noise Stand, Define Unacceptable Maneuvers

Monte Resch-Ar Line Pilot's Assn. has hardened its stand against any new procedures involving aircraft fly-by techniques and defines those techniques it considers improper.

In a formal policy announcement here, the assn.'s board of directors put ALPA's full weight behind an eight-point position first developed by the assn. major safety committee (JW May 7, p. 10). Under the new policy, ALPA is committed to reject any aircraft maneuver that could result in the following:

- Clearance or communication to change heading at low altitude.
- Turns below 100 ft. solely for noise abatement purposes.
- Flights or greater than normal power reduction on climb.
- Climb at less than maneuvering speed for the existing flap configuration.
- Approaches steeper than the instrument landing system glide path.
- Airborne procedures in weather worse than 3,000 ft. ceiling and 3-mi. visibility.
- Radio calling during climb and approach for other than ATIS purposes.
- Postarrival noise contours that can be followed in wet weather, or with crosswinds greater than 10 kt.

The most objectionable procedures in use at New York's Idlewild airport would be deemed unacceptable under seven of these eight points.

According to ALPA's policy resolution, "aircraft noise should be reduced by engineering and design and not by surgically air fly techniques." It indicated that such techniques became required when any of the eight points were breached by airport operations, air-traffic management or the Federal Aviation Agency.

Tuning of the traditional jammer behind ALPA's position at two assn. mts. held in New York on May 11 and June 1 under FAA sponsorship to discuss the noise question. During these sessions, FAA Assistant Administrator Chas. Burke said that the agency had some "very close to evaluating the technical possibilities for abating noise."

Speaking before an audience of pilots, airline officials, political leaders of surrounding communities and representatives of the Port of New York Authority—which operates Idlewild-Bridge held out "very little language" hope" for any abatement of noise abatement project at the New York area.

Training what he described as a modern industrial discipline, Burke said that centers of commerce rely increasingly on air transportation. But at the same

time that commercial aircraft are trying to bring more aircraft closer to a city, there will be more of an increasing concern to keep the citizens in a dormer.

FAA officials present at the meeting indicated they were willing to compromise on some of the pilot's points, but not all. For example, the controversial phrase—"in the interest of noise abatement, do not delay your turn to 280 deg. 7-10 no longer given to pilots departing Runway 31L at Idlewild. But they have still announced practical procedures despite pilot objections.

## Top Officials Chart Anti-Bomb Measures

Washington—After U.S. action to combat the sabotage of airlines in flight will be directed by a high-level steering committee, which will meet to review past progress and to discuss the possibility of phasing out existing aircraft in explosives.

Members of the committee, which has an executive role in yet, include N.E. Hilde, Federal Aviation Agency administrator; Geoffrey Evans, director of the FBI's special investigation unit; Alan Reed, chairman of Civil Aeronautics Board; and Robert J. Kohn, deputy U.S. attorney general, Income Tax, director of the Flight Safety Foundation. Dr. Glenn T. Seaborg, chairman of the Atomic Energy Commission, and Stuart Topp, president of the Air Transport Assn.

FAA and AEC have been collaborating recently on the bomb-sabotage problem since 1960. In Fiscal 1961, FAA allocated \$45,100 to research being carried out at Catholic University here under AEC direction. During Fiscal 1961 and Fiscal 1962, FAA plans to spend a total of \$74,000 on police research and on its share of the AEC's own program. Another allocation will be made in Fiscal 1964.

Although AEC is heavily involved in the program, an AEC spokesman said that the so-called signal giving chemicals under study need not be radioactive. Other techniques that could show promise in preventing explosives involve X-ray and fluorescence spectroscopy, ultraviolet detection by neutron capture, explosive proof search methods and radio wave detection of devices within shielded steel. Neither FAA nor AEC intends to undertake the scientific program, but personnel who take down as they study the type of psychopaths likely to sabotage an aircraft.

In a related development, Sen. George A. Senate (D-Pa.) last week introduced a bill lowering the amount of insurance that can be purchased without insurance or physical examination to \$10,000 to lessen the health problem. He said that "the unworried and ease with which it is possible to obtain a half million dollars worth of flight insurance for a few dollars worth is less than the amount of a person who would seek to derive a profit by insuring."

## JAL Domestic Profit Eases Overseas Loss

Tokyo—Revenue from Japan Air Lines' domestic routes, improved by the introduction of Concorde III jet service to Osaka, managed to offset partial losses sustained over the company's international routes to the U.S. and Europe in monthly net revenue of \$116,244 for the Fiscal 1961 year ending Mar. 31.

Representing a marked decline from the \$143,572 net income reported last month, the profit, however, profit margin was attributed to their major losses by JAL President Shunzo Matsuo at the stockholders' meeting here.

• Added competition on international routes as a result of increased passenger capacity through the continued introduction of jet service by the major airlines on the route seems apparent to JAL.

• Tightened foreign currency controls by the government which sharply curtailed travel by Japanese businessmen and tourists to foreign countries.

U.S. government's "Fly American" campaign, a recruiting factor cited by most foreign carriers competing with U.S. international airlines in U.S. passenger traffic.

While operating losses were great, JAL officials said the relatively high load factors on domestic routes as opposed to those recorded on international routes amounted for the airline's Fiscal 1961 showing in the March Matsuo told the stockholders' meeting that total revenue amounted to \$69,562,961, a 18.7% increase over the previous year's \$59,013,073. Total expenditures rose from \$49,985,806 to \$49,532,017.

To improve its international and domestic route situation, including projected new schedules to the Middle East and Europe, the airline said. A Japanese government guaranteed \$5.5-billion loan used for this purpose is now available (JW May 14, p. 50).





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## SHORTLINES

► **Allegiant Airlines** had a net profit of \$66,772 for the first four months of 1962 on revenues of \$7 million, compared with a \$402,111 loss on revenues of \$5.9 million for the same period last year. The profit is the first for a comparable period since 1944.

► **Bozell Airways** and Pan American World Airways will begin through-plane service connecting Houston and Dallas with London and Frankfurt, via Chicago. The airlines will use 707 jet equipment under a recently approved equipment interchange agreement.

► **Federal Aviation Agency** has extended for one year a rule prohibiting passenger use of portable FM radio on all U.S. commercial aircraft. Also extended was a rule prohibiting portable FM use on any civil aircraft while VHF radio equipment is in operation. FAA originally adopted the rule on May 25, 1961, after tests indicated FM use adversely affected VHF radio operation.

► **International Air Transport Association** figures show landing fees and airport taxes and user charges for the world's scheduled airlines are increasing twice as fast as traffic. IATA estimates scheduled carriers now pay \$153 million annually in charges—a 75% increase over four years ago.

► **Japan Air Lines** will extend its Tokyo-Hong Kong-Singapore route to Djakarta, Indonesia June 16. The airline will operate Boeing 700s on each route to Djakarta Mondays, Wednesdays and Fridays.

► **Shink Airways** has ordered two additional CL-44 turboprop airliners from Canadian for delivery this fall. Value of the aircraft is about \$7 million.

► **Trans-Texas Airways** has begun each service with DC-3 equipment as first aircraft waiting configuration as line discounts up to 30%. Trans-Texas says the new firm is effective 24 hr daily, seven days a week on approximately two-thirds of its total flight.

► **U.S. certified jet cruiser** airliners built for April, as reflected in Air Lines Clearing House transactions, totaled \$51.6 million compared with \$47.8 million in April, 1961. Intairline revenue total for the same month of 1962 was \$996.3 million, as against \$122.5 million for the same period last year, according to Air Transport Association figures.

## AIRLINE OBSERVER

► **Watch for Civil Aeronautics Board** to bring the elusive Honored Hagler in a written into the New York/Florida Route. Removal Case. Chances are strong that the Board will refuse to remove Northwest, Florida residents unless Hagler himself testifies, on grounds that the public interest cannot be served unless Hagler reveals his plans for the airline in the next Hagler Trial. Civil control of Northwest is given final approval. Failure of Hagler to testify in the Hagler Trial Northeast Control Case evoked some industry criticism of the Board proceedings.

► **U.S. is showing increasing concern** over steady expansion of Aeroflot routes into Africa and over the Soviet Union's plan to extend those routes to South America. Latest Africa operations is between Moscow and Khartoum, capital of the Sudan. Regular flights on the route are now being conducted by the Russian carrier.

► **French government continues** to drag its feet on final approval of Air Union, despite plans by Air France for a justice decision. Their other governments concerned—Belgium, Italy and West Germany—have indicated their approval of the joint airline. France's position is complicated by the de Gaulle government's earlier into a European agreement. Current approval—Air France, Airline, Lufthansa and Sabena—approved the plan one year ago.

► **U.S. airlines, after winning** strategically qualified Federal Aviation Agency approval to land their jets in 100 ft. ceiling, 1 mi. visibility weather (AW May 21, p. 43), now are laying the groundwork to get full Lewis maximum of 100 ft. and 1 mi. The airline alternative operation committee believes that "300 and 1" no longer poses a technical problem according to its statistics. Instead, the committee is concentrating on the Instrument Landing System and runway lighting improvements that might meet 100 ft. and 1. First indication to apply for continued lower than those now set for both jets and piston-powered aircraft could be United, which is consulting new instrumentation for its Wichita Viscount fleet.

► **Robert E. Whelan, whose resignation** as vice president of National Airlines caused a stir last month, had actually sold his entire National holdings—1,087 shares of common stock—the month before. Whelan departed after Louis B. Maytag became president (AW May 14, p. 46). Airlines April transaction reported to the Securities and Exchange Commission was the sale of 92,500 shares of Trans World Airlines holdings to the U.S. First Flamingo Social. Social, a TWA director, is a former banker for Howard Hughes and a new one of those being sued by Hughes over TWA financing (AW May 7, p. 121).

► **Interagency Committee on Transportation Matters, in its initial meeting** last week, decided that its first project will be to establish consensus criteria to determine whether mergers should or should not be approved.

► **Continental Air Lines Boeing 727 jet transport** which costed May 22 near Greenville, Iowa (AW May 23, p. 37) was fully covered by insurance and proceeds will probably be used to purchase a new aircraft. Meanwhile, Braniff Airways last week announced the purchase of a fourth Boeing 720 at a cost of about \$3 million. Decision to acquire the new aircraft, scheduled for delivery in September, 1963, was based on forecasted traffic growth.

► **First indication that Aeroflot's Tu-114 turboprop transports** are providing more than a token service over last month with the announcement that Tu-114 flights on the security Moscow-Kharkov route would be increased to twice daily. The 170-passenger aircraft are slated for three round trips daily on the trans-Siberian route beginning this month.

► **Defense Department has issued a directive** implementing a Federal Aviation Agency regulation requiring a 4-hr. hold time for all but subsonic, permitted to carry a deadly or dangerous weapon should a commercial aircraft. Passengers delivered to carry a weapon must so notify an airline representative and present proper credentials.



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## Fourth Jet Crewman Will Cost \$14 Million in 1962, ALPA Told

Many Reach-Fourth crew members in the jet cockpit—who added U.S. salaries to between \$375 and \$380 million in the past three years—will cost the industry another \$14 million in 1962, according to Continental Air Line President Robert F. Sec.

During 1959, 1960 and 1961, Sec. said the industry's jet pilots were \$27 million—a figure almost identical to the salary it paid the fourth man. Next year, he predicted, the sum will rise again and work to drive pilots that could lead to the hiring of additional pilots.

All U.S. jet transport are down to three licensed pilots under policy enacted by the pilots' union. However, an increasing number of third pilot doubles as a flight engineer. Other transportation companies, Trans World, Eastern and Pan American—employ a third pilot but retain the professional flight engineer.

Addressing an Air Line Pilots Assn. board of directors meeting here, Sec. stated that if ALPA works its power in a "coercive or selfish manner," it could force government nationalization of the airlines. If this takes place, he said, the professional pilot's job will grow less lucrative. "We I put do not believe the congress will use the taxpayer's money to pay salaries and benefits equal to those you now have."

Thomas Sec's speech was that pilots should identify themselves more closely with management efforts to turn a profit. Each captain he said, can be the president of a "jet corporation" with assets of \$6 million.

The chief executives who run public airlines with annual sales of \$6 billion earned an average of \$27,000 last year, or somewhat less than an airline captain with enough authority to fly jets into hell, he said. The executive vice presidents of these companies, whom he compared with pilot first officers, earned an average of \$10,000. Chief financial officers, who performed duties comparable to airline second officers as flight captains, drew an average of \$13,000.

At Continental, which has a highly developed cost control system, each jet flight incurs costs \$11.98 and each is made of two new ones \$3.72. If pilots, through poor flight planning, add three quarters of flight time and one minute of two time in air Continental departs this summer, annual expenses will climb \$1 million, Sec. said.

Calling for more effective use of the public's dollar system on each jet, he suggested that "indifference and laziness" which at "business approach that

the pilot leaves precisely where he is and exactly what he's doing." Passengers, he said, are not going to travel by air (JAW May 21, p. 45). "If these people overcome their fear and fly, just to have that four man-rated by lack of information on the ground or in flight, then we haven't made much progress," he said.

A carrier's reluctance get captains, to the aggregate, can "contribute materially to which airlines survive and grow and lose more pilots," he said. Although this is a serious matter, when experienced transporters are introduced it will increase new competition, for then "every pilot will have to accept responsibility for the thousands of dollars of profit or loss adjustment as the way he operates his flight," he told the ALPA delegates.

The sign posts are clear when an airline begins to suffer economically, he said. As control of costs in lost, expenditures control revenues and losses are paid from funds set aside for purchasing new aircraft. Then the big financial losses result in loss of money for flight modernization, forcing the airline into high-speed losses. Then they argued have higher losses than before which accelerate the cycle.

For example, he said, the average jet leased by the industry cost \$100,000 a mile more to operate than it would have cost to operate the same aircraft if it was owned, despite depreciation payments. "In simpler terms," he said, "eight additional passengers were required on each flight just to pay the extra cost of the lease."

When jet airlines from previous profitable years began, there was nothing left to cushion the losses for the following years and every extra dollar spent adds an additional dollar to the net loss, he said. Eventually, at times, passengers, their demands, materials and supplies mount in cost—"the airline has had it," he said.

## Delta 9-Month Income Up From 1961 Period

Delta Air Lines had a net income of \$1.5 million for the first nine months of its fiscal year, a 23% increase over the figure recorded in the same period of the 1961 fiscal year. Operating revenues showed 15% during the period to \$121.7 million. The carrier's net losses dropped 15% to \$7.25 million and net income was 25%. Operating passenger miles climbed 17% during the same period.

## Simplified Power for V/STOL Aircraft

Several industry big three companies are the optimum power system for all V/STOL, apply not only because the total net cost for fuel for both lift and forward propulsion. They point the simplicity of a single engine (propulsion) or dual engine (propulsion) engines, they provide a single and even mechanical solution. They can be achieved with a constant rate of separate lifting and propulsion engines.

### ● SINGLE-ENGINE INSTALLATION

- Simplified control system
- Simplified aircraft control
- The resultant thrust and stable flight

power through a fixed point over the aircraft and to the ground.

● Undercarriage and space requirements are simplified in one engine.

● Availability of a large power source for both lift and forward propulsion.

● The total propulsion power is able to achieve lift and off.

### ● MULTY-ENGINE INSTALLATION

● The total propulsion power is able to achieve lift and off.

### ● SUPERSONIC FLIGHT

● The two separate lift engines (lift engines) are able to achieve lift and off.

take-off and supersonic flight. The power source for both engines is the same.

● A large thrust source for supersonic speeds with early or without, because it is specific for supersonic.

● The two separate lift engines (lift engines) are able to achieve lift and off.

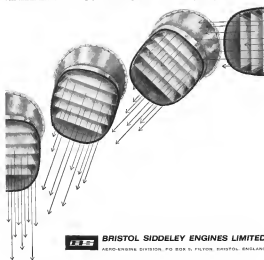
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These off-mounted JT8D's will power the Boeing 727. This concept jet is designed for profitable operation over low-density routes with 150 to 1,700 mile stage lengths.



Turboshaft JT8D features 13 stage compressor, 4 stage turbine. Compression ratio is 19.5:1. The 14,080 pound thrust design advances greater JT3 and JT5 technology.

## Pratt & Whitney Aircraft to deliver first JT8D turbofans for Boeing 727 flight tests

Sometime soon, three off-mounted Pratt & Whitney Aircraft JT8D turbofan engines will power the Boeing 727 jetliner on its initial flight—fifty more than a year after the engine ran for the first time.

Such swift progress is possible because the JT8D's basic design has been proved by more than 20,000,000 JT3 and JT4 flight hours. Capitalizing on this experience, Pratt & Whitney Aircraft has developed a lightweight, high-efficiency powerplant with 14,900 pounds thrust. The JT8D achieves this advanced per-

formance through a design concept already familiar to operating personnel at 36 world airlines.

With its trio of turbofans, the 727 can operate at full load from 5,000-foot runways. This 350-to-600 mph jetliner is designed for profitable operation over low-density routes with 150-to-1,700 mile stage lengths. To date, United Air Lines, Eastern Air Lines, American Airlines, Lufthansa, and Trans World Airlines have ordered a total of 127 planes. By 1963, the 727 will bring the benefits of jet travel to new cities throughout the world.

**Pratt & Whitney Aircraft**

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**SERVICE TEST** of the prototype of the 40,000-lb. cargo loader-unloader vehicle for USAF's 463L. Materials Handling Support System is also configured at Travis AFB, Calif., with a Boeing C-141 jet engine mounted in Military Air Transport Service. Three prototypes produced by American Machine and Foundry Co. are presently undergoing service tests at MATS base.

## 463L System Integrates Cargo Handling

By James E. Hendricks

Wright-Patterson AFB, Ohio—Prototype, and production contracts for about one-half of the cargo handling equipment for USAF's 463L Materials Handling Support System will be awarded by Automated Systems Division here within the next three weeks.

Keyed primarily to integration with the C-141 Starliner, the handling infrastructure developed by Lockheed Georgia Division (AW Oct. 9, 1961, p. 56), the 463L system is designed to get the Air Force a simplified, rapid transit cargo control and shipment operation by 1967—operational target date for the C-141.

Approximately 55.5 million has already been spent on research and development work on the 463L system, much of that was for development of prototype equipment. ASD is requesting another \$16 million to R&D funds to complete that portion of the program by the end of Fiscal 1963. USAF estimates total system cost through Fiscal 1965 at about \$64 million, although the figure might creep as high as \$100 million covering final purchase of related gear at Air Force bases.

Commercial cargo operations might also take the output of the 463L, and C-141 program was built with design work by both military and commercial units in mind. The C-141 is the first airplane ever planned to divert its

development with a family of cargo handling gear.

The view that the Air Force is placing on consideration of the two systems in development and operation is this: It will be the first that both are managed here under the new, central System Program Office (SPO) headed by Col. M. B. Thompson (AW Sept. 75, 1961, p. 20).

### Other Aircraft

The 463L equipment will not be used exclusively with the C-141. Air Force is working toward application of 463L techniques and equipment to several other types of jet and propeller-driven transports. These include the C-119 and its air counterpart, the 707, the DC-8, DC-7, Constellation C-117, C-124, C-130, C-115, CL-44 and Argos.

The Argos could drop out of the program according to Lt. Col. M. E. Peterson, who is in charge of 463L development within the SPO. Reddy Arnesen, the chief of U.S. cargo planes which had been given the Argos, has turned its service equipment back to the British manufacturer. Whammoth Greiner, The English company, is about to sell these assets to Capital Airlines (AW May 28, p. 4).

There are other two intentions of 463L's effect on civil cargo carriers. Military Air Transport Service (MATS) and Logan, which serves USAF Logan Air Command, are offering contract in-

contract to commercial carriers who will adapt their planes and operations to 463L concepts and equipment for such flights.

Also, a contractor of the National Scientific Industrial Aerial, is studying the application of 463L to the civil cargo field and is conducting its studies with the SPO.

United Airlines Agency and the other military services are working in direct liaison with ASD in development of the C-141 463L program. Other working groups at Department of Defense level, composed of Army, Navy and USAF members are working to assure standardization in equipment development.

### Contracts Due

Selection of responses to contract prototypes and produce 463L equipment will be handled by ASD in system manager. The study, from which 463L evolved, was completed two years ago by Douglas Aircraft Co. (AW May 1, 1960 p. 145).

Contract awards will be parallel processed in DOD policies which dictate equal consideration for small business. There are the first funds allocated for production within the program. The

following production and R&D awards are due by June 30, the end of the current fiscal year.

•**Cargo loading system.** The equipment is divided into three separate systems for installation aboard C-124, C-130 and C-119 transports to convey and secure cargo in pallets inside the aircraft. Each system consists of four rows of rollers connected with two forged guide rails and pulley blocks.

The C-124 and C-130 system will include lateral movement capability to position 55-in. and 105-in. pallets. The C-130 system also is to include features permitting unloading of USAF and Army materials carried on the standard 105-in. Army aluminum loading pallet. ASD is evaluating industry proposals to furnish 41 units for the C-130, with the supplier to be picked this summer. Douglas is producing the C-130 loading system under a \$1.5-million contract. USAF plan to use the C-131 primarily for transporting the Macomber RCM and Vinten 1 booster optic systems weighing 50,000 to 60,000 lb. American Machine and Foundry Co. has developed a prototype of the C-124 system, and USAF will determine a supplier and award a production contract during Fiscal 1963. USAF will purchase 40 of the C-124 systems, which will be installed on first line aircraft, those in direct support of the war areas.

•**Cargo pallets.** Goodrich Aircraft Corp. has a contract to furnish about 1,400 small pallets, measuring 55 x 54 in. USAF will select a small business contractor to provide about the same number during Fiscal 1965. Total small pallets will be about 55 million. The small pallets, which will be used in the C-125, C-124 and C-119, will have a 5,000-lb. capacity with a 95-in. stacking height. They are to be so transportable in places not equipped with the cargo loading system by having them to be down from 40 ft.

Goodrich produced approximately 1,000 large pallets, 60 x 60 in., during Fiscal 1961, and these were later sold to the Air Force. Deere Inc. tractors produced 250 the same size for the Air Force. Total of 2,800 large pallets will be produced in Fiscal 1963 with the contractor to be chosen by June 30. Another 1,000 will be bought in Fiscal 1963, making the total funding for large pallets approximately \$3 million. The large pallet will have a 10,000-lb. capacity, with other specifications previously the same as the smaller version. USAF is the consolidating products at its 88 x 118-in. pallet, Air Force will receive 100,000.

•**C-130 unloading ramp.** R&D contract on this item is scheduled this summer. The system is designed for attachment to the C-130 loading ramp using tail-down fittings. The 40-ft., air-

transportable ramp is intended to handle unloading of heavy palletized cargo at forward area airfields where main sophisticated gear is not available. Design requirement calls for a telescoping, folding or collapsible system which can be operated manually or automatically by two men and which will accommodate a 160 C-130 load of 60 in. and 105 in. pallets. Design weight objective is 500 lb.

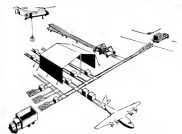
•**40,000-lb. loader-unloader truck.** The truck, already available in prototype form from AMF (AW Sept. 12, 1961, p. 81), is scheduled for use only at large, heavy traffic cargo terminals, such as the couple MATS bases. The vehicle, driven by its operator seated in a hatch at left front side and over the conveyor and cargo bed, has a governed speed of 15 mph. The 40-ft. long vehicle can adjust its height to fit high or low floor aircraft. It is to be capable of emergency shifts about the C-113, with its height retracted during ascent to 80 in. and width to 128 in. Other specifications include 40 to 150 in. length, 100-in. wheel base and 100-in. wheel pitch, 5 deg. roll, an 8,000-lb. capacity weight, ground loading ramp which must, load-operated pallet loads, pallet push-back capability at the front, a power drive system, and the C-130 around the axle for cargo handling personnel. By June 30, USAF will award a production contract for 14 of the vehicles. That is also in severe tests at Travis AFB, Calif., McGee AFB, N. C., and Tachikawa, Japan. In a recent test conducted at the new cargo terminal at Yuma, the 40,000-lb. truck and four units loaded and unloaded 50,000 lb. of cargo from a

C-131 in 18 min. USAF is seeking a 30 min. block time for cargo transport annually. That includes loading and unloading a plane while it is being refueled.

•**25,000-lb. loader-unloader.** AMF has the prototype used on the vehicle also and it is similar in some respects to the larger model. This 25,000-lb. cargo truck will begin service tests in November with Tactical Air Command at Page AFB, N. C., and Stewart AFB, Tenn., and with Logan at Ogden Air Materiel Area. This smaller vehicle is designed as a workhorse vehicle at most small and medium-sized personnel bases, but will not be used in forward areas. Air Force plans to buy 165 in Fiscal 1963.

•**Cargo loading trailer.** This adjustable height vehicle will be towed by a prime mover and will be utilized in forward areas for use in supporting crew group operations, such as used for the war. The cargo bed will be fixed with four rows of rollers oriented to accommodate palletized or odd-shaped cargo in vehicles with high side loads. Period will be 35,000 lb. It will also be mounted at large permanent depots to supplement the 40,000-lb. loader, for example, it could be towed behind the large loader and carry 11 of the large pallets to make up a 160 C-131 load in one trip from the storage point to the place. An R&D contract for the trailer is due June 30.

•**Palletized cargo trailer.** Initial Fiscal 1963 procurement will total 1,000 trailers, with 100% of the order set aside for small business. The trailer has a removable left side transfer plate as a cargo bed, preventing removal of the



**EMERGENCY TERMINAL**, shown in USAF staff's concept, is proposed for loading to forward areas during busy war to handle flow of air materials. Large portable machine would provide weather shelter for palletized cargo.

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trials in any direction without the need to turn the trailer. Two sets of fork lift rollers will be used to load and unload cargo or to tilt the trailer for steep ascent with a high-draw aircraft. Each trailer has a 10,000-lb. capacity, a 110-in. long by 96-in. wide and 15-in. high, and has small center wheels. The trailer will be equipped with locking devices at each end, enabling cargo handlers to tow several trailers in a train at a speed of 5 mph. In Fiscal 1963, USAF will purchase another 140 trailers, completing the order.

• **Rough terrain loader.** RMD contract is for, Item 30 on this device, which will be used to load cargo short distances over uneven surfaces at heights of various roughness bases. Resembling a flatbed truck mounted on tank treads, the vehicle will load and unload cargo from rear-loading truck bed height places. The rough terrain loader is to have 25 mph speed capability, 58-deg side slope capability, 10-in. grade climbing and loading depth capability, and a 30,000-lb. payload. Length will be 170 in., width 110 in. maximum 1100 is for an transport, and height 37 in. to the top of the control box. The cargo bed will have four rows of rollers on covers adjustable height at 37 to 68 in. 5-deg tilt capability, pitch levels of 5-deg forward and 16-deg aft, a ground loading ramp, an 8,000-lb. capacity winch, and hand-operated pulley blocks. Another gear is to include a ballast for use for unloading and the forces in front of the loader, new rear-end blades and a ground lock.

The 4631, RMD also is planning the development and order of these items of equipment to meet out the load-carrying portion of the cargo handling process.

• **Emergency towing pulley.** USAF hopes to wire an RMD contract during Fiscal 1963 for the new intended for use by tactical units to prepackage repair materials and supplies in a manner of reducing ground crew workload. The pulley will be designed for transport with the loading system around military cargo airplanes and for unloading capability from the C-123, C-130 and C-141. Recently, USAF wants a lightweight suspension pulley that has two 58 x 48-in. with 1,000-lb. capacity and 58 x 108-in. with 30,000-lb. load. It is to have 7,500-lb. capacity bed-down raps along the sides, fork lift rollers and auxiliary storage capability in all types of climate.

• **Integral weight and balance system.** The system is slated for the C-130 and will indicate accurate weight and balance loading factors while the aircraft is on the ground or in flight. The system will utilize pressure sensors located in the loading gear and main gear and will feed pressure data back to a com-



Boeing Studies Effects of Vibration on Pilots

Vibration between 1 and 30 cps with amplitudes of 20 in. at lowest frequency may be felt in at highest frequency are produced by turbine engines creating a platform building up smooth and at Boeing White. Motion, aircraft vibration effects on vibrations on human performance are being conducted by Office of Naval Research. At high vibration frequencies, pilots have difficulty reading some aircraft instruments, controlling controls. Other effects are hard to see, but they exist, and some are under test.

ports within the vehicle. The computer will furnish weight and balance computations translated into standard read-out data on information in the flight cabin and on the loadmaster's display board in the plane's instrument. The indicator will give the pilot a go, no-go reading based on aircraft center of gravity, and takeoff weight computations. It features the criteria are to include a weight of about 30-lb. and represent potential for pre-out of weight and CG information, fully automatic computation of fuel data, automatic wind correction, and loading planning information and measurement and recording of loading speed as related to possible CG shift about the plane. USAF plans to select a contractor during Fiscal 1964.

• **Special weapons handling equipment.** This proposed system, with a prototype development using test for Fiscal 1963, is designed for safe movement of large nuclear weapon components, up to approximately 75,000-lb., aboard all military transports. In rough design, it resembles a cargo pallet with additional crane, winch-type devices and winching apparatus to secure the component and protect it against damage caused by contact with hard surfaces during loading or offload.

• **Autoline draw winch.** USAF will purchase 32 of these winches as an initial order and will have more in order cargo aircraft winch unit out. The powered portable winch is driven by a 200-hp, 480-cps hydraulic power unit. It will be installed on military transport vehicles and will have a 6,000-lb. capacity, 1,500-lb. greater draw with support winches runs in use by the Air Force. The new winch will offer 700-lb. of mobile cable with cable speed ranging from 10 to 50 ft/min. The winch will be mounted within the aircraft in two locations and there will be two handles at end of the winch. All American Engineering is developing this type of device, and USAF will choose a supplier in fiscal 1963.

• **Fork lift.** USAF will buy two sets of 6,000-lb. and 10,000-lb. capacity. Both will have adjustable mast height to enable the operator to maneuver under the wing of a transport aircraft. Yale Co. of Torrington, Conn., has modified a 15,000-lb. fork lift truck by reducing the mast height and the capacity to 10,000 lb. and extending the load capacity to 45 in. This truck has been given priority.

USAf plans to buy 300 fork lift trucks in fiscal 1963 and 150 in fiscal 1964 before a fiscal 1962 order for 100. Hyster Co. has also developed a prototype device. All types of 10,000-lb. pallet follow-on order will be awarded through DOD's Defense Supply Agency.

• **Platform lift truck.** Service tests are conducted at Vicksburg AFB in this area, a self-propelled, narrow rail vehicle with the rider's controls and load platform mounted to the carriage. The truck is designed for use in stacking or removing platform carts from the latter and in loading side-by-side rows of high density cargo in warehouses where narrow aisles and low door-lift heights prevent the use of less maneuverable and heavier equipment. The truck has a 1,000-lb. load capacity, 2-4 mph speed with the platform below 20 in.



## How to enhance reliability of critical avionics equipment!

A good component design, proven under laboratory conditions, may sometimes perform unsatisfactorily during field life. Why? Consider the type of component used. Are they field proven? Do they offer documented reliability?

Take the case for electronic vacuum tubes. Tests by ARINC Research Corp.<sup>1</sup> illustrate the dramatic improvements in tube reliability since 1954. The results of tests conducted aboard naval vessels, for example, show a continued tube survival rate of 15% per 1000 hours in 1954. By 1960 this figure dropped to 1.2% for miniature tubes, and a remarkable 0.18% for subminiature tubes. All the controlled subminiature types in this list were Sylvania tubes.<sup>2</sup>

Electronic tubes are virtually unaffected by extremes in environment. Example: Sylvania G4 Cold Beam Tubes, specifically designed for low heat sensitive avionics, main-

ten must perform even after shocks of 90G, fatigue tests of 2.5g for 50 hours, both temperatures of 165°C. They are unrivaled in electrical stability, consistency and ease of interchangeability.

If avionics equipment reliability concerns you, be specific about the components you use. Make certain they are superior quality electronic tubes—look for the Sylvania G4 Cold Beam markings on the tubes. A complete list of G4 Cold Beam types, and prototypes, is yours for the asking. Electrons Tubes Division, Sylvania Electronic Products Inc., 1100 Main St., Buffalo 5, N. Y.

<sup>1</sup>Source: ARINC Research Corp. as published in publication ARINC 44-146, ARINC No. 300.

<sup>2</sup>Tubes were subjected to eight shock tests, including explosive drops to impact velocities indicated; thermal stresses from extreme thermal up to 100°C at ambient; 100% continuous operation of heaters; 5000-hour maximum duty inclusion—50% duty, 50% duty, 50% duty, 50% duty, 50% duty.

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and 1 mph above 50 in, maximum lift height of 100 in., and a platform 48 in. long by 42 in. wide. The test at Fort Worth determines whether USAF will issue a procurement order and in what quantity.

•**Flashed trailer kit.** Strategic Army Depot near San Francisco is assembling 30 of these units for shipment to Pacific area where they might be used in emergency operations. The kit will provide for last-level modification of civilian modified trailers to accommodate 402L pallets. The kit is to include connectors, guide rails and platform material for increasing trailer bed width as required. Use of the trailer requires a motor vehicle and a winch, but it is much less expensive than the purchase of large trailers at bases where they would receive subsequent use.

•**Insulated food containers.** USAF will determine its requirement for these by end of Fiscal 1967. They will be used primarily to transport frozen foods to remote stations, such as the Arctic DEW (Deer Early Warning) Line sites. USAF is considering three, with capacities of 400, 300 and 1,500 lb. The containers would be mounted on the standard cargo pallet and would incorporate a temperature gauge. They must be able to provide thermal protection for fresh and frozen foods for periods up to 30 hr. at temperature extremes from -20°F to 100°F. The containers are to have lock lift devices and handles on the sides for hand carrying. ASD may award a pilot contract in the near future for such low contract.

•**Consolidated container.** This is to be an expendable, triple-walled, corrugated fibreglass box with dimensions compatible with one eighth, one fourth and one half the size of the 108 in. pallet. Small sizes of cargo with a constant distribution and dispersed gravity can be fitted into the outside draft container to save space and loading/unloading time. The boxes will be available in 27, 48 and 54 in. heights. ASD wants to receive test the three sizes of containers by MATS and Luger operations before making a decision on their worth. If accepted as a piece of 108L equipment, the fibreglass boxes would be a final purchase item.

•**Conveyerized lock lift trailer.** An other local purchase item, the device consists of a conveyer belt fitted with cranes for the bases of the 1080L lock lift. The trailer is to be used for loading and unloading pallets from either a high or low floor aircraft. The conveyer belt is equipped with restraining locks for the pallets and has hand rails and walkways at either end for manual handling of an electrical pallet.

•**Cargo net rack.** This equipment will be purchased for the major cargo trans-

ports to fit protective netting over palletized cargo. It is basically a metal frame folded down by a lock that is used when protected by the pallet, the net frame is raised above the pallet, and the net is lowered into position and secured. The net is stored by spring loaded hooks on the rack. When the net is raised, the pallet, the frame is raised again, and the hooks discharge automatically from the act.

### Cargo Terminal

The first cargo terminal to meet needs a major portion of the 108L system next in operation at Travis Air Force Base, and much of the nation's equipment is being sent to that base. Travis is MATS' cargo, passenger and cargo terminal on the West Coast.

In the new layout terminal, crates containing goods and supplies are sorted and weighed automatically, sorted and weighed by hand in a position where they are prepackaged according to priority and destination, or transported to a storage point to meet pickup. The electro-mechanical cargo scales can handle cargo items weighing up to 500 lb. at the rate of 551 items per hour.

The Boeing Co., manufacturer of MATS' C-119 jet transports is equipping the aircraft at the factory with side rails which facilitate guidance and lateral and vertical control for 402L pallets.

The rails are laid out so that the pallet can be inserted lengthwise, as necessary into the cargo carriage. Rail cars and a ball bearing plate are used to move the pallets under the C-119 transport.

MATS and Luger also are examining jet aircraft using existing military cargo aircraft to handle their goods. With the half trailer plate at least to enable, cargo loading and unloading of the pallets, which are mounted inside the aircraft, to standard cargo box between cargo.

Eventually, all USAF bases will have mechanized cargo handling to meet, deems, Parsons says. This might mean the use of only a few lock lift and pallet trailers, as it is not a completely mechanized cargo terminal, palletized along the lines of the Travis terminal. But for as many bases will be to fully mechanized under the 402L program. MATS will accelerate its major parts of consolidation, and Logistics Command will approach its Air Materiel Area (AMA) under guidance of the 402L program.

ASD helped to design plans for the automated AMA at Ogden, Utah, McClinton, Pa., and Warner Robins, Ga. Initial 402L plans call for automating cargo terminals at Dover AFB, Del., Chidwell AFB, S. C., McChord AFB, Wash., McGuire AFB, N. J., and Charleston AFB, France. MATS also wants

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the terminal at Kadena, Okinawa, unloaded, according to Peterson.

The rough design for a typical 461L, submitted recently, shows a series of conveyor belts extending from a track extending deck inside the main cargo building. The automatic sorting and weighing devices separate the piles of cargo by priority and destination and route them along other conveyor belts further inside.

The cargo is loaded separately at an entrance above pallets mounted on spring-loaded platforms which rise at floor level or below in pits. Once palletized and secured with a cargo net, the cargo is transported, probably by fork lift, to an area set aside for the point of destination. The cargo is also separated for off-loading priority, so the unit it is to be carried aboard an aircraft making more than one stop for unloading. This allows the cargo to be off-loaded first to be loaded last or next at the door, within weight and control priority considerations.

When the aircraft is ready for loading, a 41,000 lb. (15,000 lb. loaded) is pulled up to the front edge of the terminal, and the pallets are moved on fork lifts and placed on the loader for the short trip to the plane.

ASD also is preparing an air transportable terminal, drawing on p. 27) which could be moved to supply the troops at forward bases during emergency operations. It might consist of temporary cargo weather shelter, roller conveyor which could be raised on the ground, and the rough release loader.

The shelter would be constructed of lightweight sectional components to provide rapid and easy erection without the need for special tools. In dismantled form, the shelter and related gear could be transported and uncrated, if necessary, from cargo aircraft. All equipment used at the emergency terminal is to be composed of modular sections capable of multipurpose use and exclusive maintenance.

The temporary terminal would facilitate the heavy flow of supplies, parts and supplies which usually begins at about D+5, or five days after the emergency of an emergency such as a land force war. ASD may use an R&D contract for the terminal design, with the first phase calling for study of basic parameters and required equipment.

USAF has established three broad goals to the practical development of the 461L system and the C-119.

- Unification of cargo operations. This encompasses the separation of cargo by destination and priority and the basic loading facilities of each into a load carried by the consolidated container. It also calls for standardizing handling equipment, particularly the pallets and aircraft loading systems, so that cargo can be shifted easily on its pallet loads



**DH-125 Seating Shown**

De Havilland DH-125 seats at Honey Air Show shows possible seating arrangement for passengers, with first row of seats being removed. Photographs are fitted. Seating Viper 20, some cargo in use in Fugate-Durham PD 100 Viper jet. De Havilland is showing the DH-125 with European defense aircraft for a combination of military use, ranging from a bomber to a transport. Based Air Force currently is studying an order for 50 airplanes in a variety of configurations. The Viper jet, which also will use General Electric CRJ60 turboprops will carry up to 10 passengers. Two prototypes of the airplane are currently being constructed by Fugate.

are transport to surface or sea-going vehicles or vice versa. Another distinction is in the packaging of strike force materials for Tactical Air Command. TAC wants its materials in 54 in. pallets for air transport. Two 54-in. pallets can be joined on one 108 in. model, flown to aircraft set up in an emergency area, broken down again into two 54-in. pallets and loaded aboard a TAC aircraft for air transport or forward unloading on the ground near the front lines to lessen the vulnerability of the aircraft to enemy attack.

• Cargo handling automation. This is an accurate statement in terms of time and money. USAF has set up to 515 per ton savings can be realized in the use of 461L equipment at forward bases. In the use of cargo per month. Additionally, mechanization of cargo cargo stations should enable these terminals to multiply their role handling capacity by a factor of four during emergencies. For cargo, the new TAC terminal now handles a daily average of 100,000 lb. of cargo. With full 461L capability, that terminal could handle up to 1.2 million pounds daily in terms of emergency, Peterson says. The 400% increase will call for some extra manpower and storage of some cargo outdoors, he adds.

• Priority and single-document control. USAF wants a two priority method to determine an assignment of materials. The present system has four priorities, numbered 1-4, and each in 461L groups—1A, 1B, 1C, 1D, 2A, 2B, etc. Top priority would require a series of equipment and would include about 20 to 30% of the total cargo operation, according to Peterson.

and jump up to as much as 100% in emergencies. The second priority would be all other cargo eligible for shipment by air as determined by an automatic control system.

The more the single-document control of cargo stream appears to be similar in a long series of moves to reduce the maximum amount of paper work that has been planned, the military is most of its operations. DOD is currently developing programs called "M4800" and "M4800" to trim the number of cargo bills and control documents in the shipping movement needed to keep track of cargo movement and priority. Peterson says these systems divided with 461L requirements.

ASD's current control system for 461L operations is planned for R&D loading during fiscal 1965. It will eventually be linked with USAF's global 461L communication system.

The information would incorporate three major components. One is a label printer, a small machine which could provide one label adequate for complete marking of cargo from source to exit, operating at the rate of four labels per minute. The printer would have a life expectancy of 10 years.

The second is a shipment planner. It is a computer device which will be employed at the point of cargo origin to combine all available shipping data and determine method of shipment, priority, and the shipping agency to which the cargo will be assigned.

It will receive progress on cargo actual status and location and forward orders. The device also will provide a key punch Transportation Accounting Data (TAD) card, which will control cargo





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flow, and summarize accurate control data for tactical operations and statistical reporting.

A third proposed subsystem component is a data integrator which would receive and store input data from advance cargo reports, cargo receipt cards, shipment cards and flight schedules. Major functions would include loading/unloading, load planning, statistical control and provision of loading data.

The C-141 and its associated 40-ft. cargo handling equipment has been given the post program designation of W-141, by ASD. Future operations, the aircraft and the handling equipment will be related to each other. For instance, the pallet conveyor which must be installed in a retrofit case on most transports will be built into the StarLifter.

Parametric studies indicate that the C-141 can airlift two 55,000 lb loads in sequence without disturbing the aircraft's control and gravity, according to Maj Gen Roberts. 45th plan and program officer. Troops and cargo can be airlanded simultaneously, with troops moving from the side loading door and the cargo being ejected through the jettison door at the rear of the cargo envelope.

Although no development contract is planned at this time, ASD is considering the installation of high density ab-fabric personnel seats for extremely long troop transport missions. On the type of flight, an 84 or 104 sq. pallet could be loaded in place at the forward end of the cargo area to provide a unitized modular station containing food, water and toilet facilities, Roberts says.

Liquid oxygen installation will be installed in the landing gear pods to furnish emergency oxygen and two 40-ft. 20,000 lb. lifts can be carried in the pods. Other lifts can be added in storage area along the loading edge of each wing.

The StarLifter will have expandable for carrying up to 127 paratroops, with seats divided into a row along each wall of the fuselage and two rows running along the center. The aircraft will be able to transport 154 ground troops in this seating configuration, since this requires less personal equipment than the paratrooper. However, the seating capacity and configuration probably will be governed by train and ventilation equipment available at the base of various jumps in its capacity.

Oxygen supply can also offset personnel loading capacity. The oxygen-gas oxygen system will be able to serve a load of 156 troops for three hours at 75,000 ft. altitude.

On medical evacuation flights, the StarLifter's cargo envelope can receive modular 38 personnel litters stacked three high, with eight attendants.



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VOUGHT-RYAN HILLER XC-142 in-service VTOL transport shown in model form with wings in vertical or lowering position, was designed for good handling characteristics and growth potential. Engines are General Electric 164s.

## XC-142 VTOL Transport Design Emphasizes Minimum R&D Risks

Design features of the Vought-Ryan-Hiller XC-142 in-service VTOL transport emphasize good handling characteristics and minimize research and development risk in the principal components of the aircraft.

Examples are:

- Mechanical integrator linkage to automatically transfer control motions from one control surface to another as wing tilt angle changes, simplifying control during transition between vertical and horizontal flight.
- Overrunning clutches between each propeller and engine and 8,000 rpm cross-shafting between the four engine gear boxes to permit engine shut-down in flight without disastrous effects on control.

• Leading edge flaps on the outboard side of each engine to prevent upflow of propeller slipstream during transition from vertical to conventional flight from producing wing stall.

- Dual screwjack actuators in the wing tilt mechanism to provide fail-safe reliability and sufficient stiffness to allow for wing elasticity.

• Conventional propellers and a horizontal tail rotor were designed instead of the cyclic propeller pitch control sometimes proposed. Cyclic propellers would add one more development risk to the program and could not offer the costed power or developmental versatility of the tail rotor. It is easier to change the diameter or speed of a tail rotor than it is to revise the design of a propeller cyclic control system.

During transition from conventional flight to hover, the mechanical integrator linkage shifts yaw control power from the rudder to differential collective pitch propeller control and finally to the ailerons in the propeller slip-

stream. Pitch control shifts from the all-movable horizontal stabilizer to the tail rotor. Roll control shifts from the ailerons to differential collective pitch control of the propellers. Control modes overlap to make transition smooth. All primary flight controls are powered by dual hydraulic systems. The tilting wing is equipped with full-span double-slotted flaps. The outboard flap sections also serve as ailerons.

The wing has an aspect ratio of 8.6 and can be tilted to an angle of as much as 100 deg., enabling it to hover in a tubed. Tail assembly of the XC-142 consists of a conventional vertical fin and rudder, an all-movable horizontal stabilizer and the eight-foot diameter tail rotor which is driven from a fuselage accessory gear box connected by an 8,000 rpm, takeoff shaft to the engine cross-shafting. The XC-142 is powered by four General Electric T64 turboprop engines developing 2,850 hp. each. The 15.5-ft.-dia. four-bladed propellers are being developed by Hamilton Standard as are lightweight gearboxes.

### XC-142 Specifications

|                             |   |
|-----------------------------|---|
| Cruise speed                | 250-300 kts.  |
| V <sub>max</sub>            | 300-400 kts.  |
| Combat radius               | 200-300 stat. mi.   |
| Ferry range                 | 2,200-2,600 naut. mi.   |
| Payload                     | 8,000 lb. (32 troops)   |
| Cargo compartment size      | 30 ft. x 7.5 ft. x 7 ft.  |
| Cargo aisle                 | Dimensional limitations 50 ft. x 30 ft. x 17 ft. & gross weight of 35,000 lb. |
| Wing span                   | 67.5 ft.  |
| Length including tail rotor | 58 ft.  |
| Height                      | 26 ft.  |

Engineers on the project claim good growth potential for the XC-142 with more powerful engines. With a slight increase in wing span and some strengthening of structure, a more powerful version of the aircraft should be able to carry a payload of six tons with a STOL capability of clearing a 50-ft. obstacle in less than 500 ft.

## PRODUCTION BRIEFING

Electronic Specialty Co., Los Angeles, will design and manufacture a 4-ft. mobile support instrumentation van for the Army's Pershing missile under a contract exceeding \$760,000 from Martin/Orlando, Pershing prime contractor.

Sud Aviation of France has ordered simplex and multiplex versions of the Smith automatic landing system for installation in two Caravelle transports now at Toulouse.

Massachusetts Institute of Technology will perform additional research on re-entry physics and range measurement using a \$4.8-million USAF contract sponsored by Advanced Research Projects Agency (ARPA).

Shawnee Industries, Inc., Shawnee, Okla., has received a contract from Lockheed Georgia Division to manufacture doors for the C-141 turboprop USAF cargo transport.

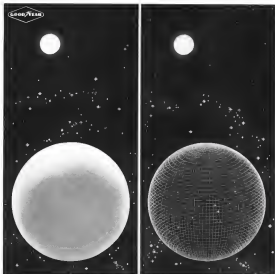
Republic Aviation Corp. has received two Navy contracts totaling more than \$1.5 million to design and develop a steering and diving control system for Navy's Dolphin experimental submarine and to design and fabricate a ship's control and training device for the Lafayette, a Polaris-launching sub.

Bell Helicopters has turned over the first four of 16 HU-1B Iroquois helicopters equipped with six SS-11 guided missile launchers to the Army for field evaluation at several bases.

Collins Radio Co. will furnish communications—identification—navigation (CIN) systems for Republic F-105 Thunderchief jet-fighters.

Ling-Temco-Vought, of Dallas, Tex., plans to hire 1,200 more engineers this year for work on space, missile, aircraft, electronics and commercial programs.

General Precision, Inc., Banglontown, N. Y., has received a \$1.8-million Federal Aviation Agency contract for work on the training and terminal data processing and display equipment at the National Aviation Facilities Experimental Center (NAFEC) near Atlantic City, N. J.



### IDEA: Build a communications satellite that's solar-pressureproof, but a mirror to microwaves

It's made of an inflatable rigid wire-mesh framework covered by a photoconductive film. The idea behind it: the film reflects sunlight in space and disappears. This leaves a microwave antenna virtually unperturbed by solar pressure, impervious to satellites.

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## EQUIPMENT



B-57 bomber is lowered into position at Keflavik AFB, N.M., for weighing and determination of its center of gravity by electronic computer.

### Computer Determines Weight, Center of Gravity



Center weight and center of gravity of two B-57 bomber fuselages have been obtained by use of an electronic weighing and computer plotting system designed CFAM-6 and built for USAF by the Electronics Division of Builders-Lane-Henderson Corp., Wilkes-Barre, Pa.

CFAM-6 system (Computer Plotting and Aircraft Weighing System) can compute for crew and loading gear spacing variations. System was originally designed for cargo aircraft and has been built for and delivered to Military Air Transport Service, Wright-Patterson AFB, Ohio.

For cargo aircraft, the computer can calculate cargo weight and placement for up to 13 compartments and indicate the maximum weight which can be loaded in each. System will hold load records on magnetic tape and print a load proof to show compartment loading and maximum gross weight and center of gravity.

Each platform has a capacity of 500,000 lb. Each has two 3121 load cells with strain gauges bonded to a load-measuring column. Aircraft weight on the platform imparts a stress to the column which is measured by the gauges then converted into electrical signals which are fed into the computer.



Now gear is positioned on platform which rests on load cells and puts in the load record. Two has been detached. Main gear main lines rest on separate platform. Readouts for weight and center of gravity appear on a window on control console, shown above left.



*The Lincoln Laboratory program for ballistic missile range measurements and penetration research includes:*

## EXPERIMENTAL RESEARCH

Measurements and analysis of ICBM flight phenomena for dissemination and for design purposes, including optical, aerodynamic and RF effects.

## SYSTEM ANALYSIS

Studies to apply research findings to enhance the technology of ICBM and AOBM systems.

## INSTRUMENTATION ENGINEERING

Designing radar, optical and telemetry equipment with which to measure ICBM flight effects under actual range conditions.

## RADAR SYSTEMS RESEARCH

Extending the theory and application of radar techniques to problems of dissemination, countermeasure and performance in a direct target environment.

## HYPERSONIC AERODYNAMICS

Study of the flow fields around reentry bodies and various body designs and flight conditions. Excellent computer facilities available.

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Theoretical and experimental studies in radar back scattering, interaction of RF radiation with plasmas.

**A more complete description of the Laboratory's work will be sent to you upon request.**

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## NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

**RESEARCHERS' ORGANIZATION, R. I.**  
Brake Corp., Route 1, Wrentham, Mass. 01963—\$100,000 for research on the design of a new type of rocket engine.

**Wallops Flight Facility, Wallops Island, Va.**  
\$100,000 for study of various effects of increased acceleration on man in flight.

**Brake Corp., Route 1, Wrentham, Mass. 01963**  
\$100,000 for study of various effects of increased acceleration on man in flight.

**University of Colorado Boulder, Colo.**  
\$100,000 for research on the design of a new type of rocket engine.

**University of Texas at Austin, Texas**  
\$100,000 for study of various effects of increased acceleration on man in flight.

**Brake Corp., Route 1, Wrentham, Mass. 01963**  
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## How to keep a high-speed hydrofoil on an even keel?

To prevent hydrofoil ships from porpoising, a radar altimeter, capable of sensing height changes of as little as one inch, is now being built by Ryan Electronics. It will be used to automatically sense waves — automatically adjust underwater keels — and keep the ship riding smoothly—even in rough seas.

Ryan Electronics is designing and producing three types of radar altimeters (phase, FMCW, and pulsed) that bridge the broad spectrum of earth and space requirements. This total capability results from Ryan's 15 years' experience in the design and development of electronic systems and the company's present position as the leading producer of Doppler navigation systems for all types of aircraft.

Flexible and fast-moving, Ryan is also making significant contributions in other areas of aerospace progress. The company has major roles in two of the newest and most promising WSEOL aircraft designs—the Ames VZ-71 and Tri-Serve C-142 research aircraft. Ryan is the largest producer of jet target drones for the Armed Services. Other Ryan activities are Flex Wing gasbags, space structures and ground support systems.

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**WET-GROUNDING** defense is facilitated by Ryan Doppler Navigation Systems which make possible accurate, continuous, all-weather navigation over land or sea—anywhere in the world, without outside navigational aids.



**SURVIVOR SPACRAFTS**—Ryan Electronics was selected by Hughes Aircraft Company, Inc., to design, develop and fabricate the Radar Altimeter and Doppler Velocity Sensor equipments for NASA's Survivor Lunar Soft Landing Spacecraft.



**RADAR ALTIMETERS** are being designed and built by Ryan Electronics for the Saturn launch vehicle. These short-pulse, high-altitude radar altimeters will be capable of recording altitude measurements up to 250 miles.



Astronauts Virgil I. Grissom (left), capsule communicator and John H. Glenn, Jr. (right) listen to radio communications at Cape Canaveral.

Doing Carpenter's bidding. Right.



Livingston G. Rahn: chief of flight operations, NASA Manned Spacecraft Center (left) "go" sign in Mercury Control Center.

## Mercury Team Supports Astronaut Carpenter During Flight



Astronaut Scott Carpenter reclines in Mercury capsule Aurora 7 at Cape Canaveral, Fla., prior to takeoff flight which began at 7:45 a.m. EST May 28. Note reflection of technicians on faceplate. Carpenter said the only time he was comfortable in his position was during weightlessness (AV, June 4, p. 36). After landing at sea, Carpenter left capsule through its service neck.



Carpenter's blood pressure is measured by Air Force Lt. Col. E. W. Nelson on board the USS Intrepid. Nervous attack recent crisis to which the astronaut was taken after flight.



Nelson helps Carpenter out of pressure suit and places the Intrepid (left). Center and right photos show Carpenter at Grand Turk Island where he was taken for medical examinations and debriefing. Astronaut Lt. Col. Walter B. Nelson in radio photo with Carpenter's backup.

# Compact Bioastronautic Sensor Tested

By Barry Miller

Van Ness, Caldwell-Snell, lightweight device based on a previously observed physiological effect may offer a simple, noninvasive method of obtaining important readings of respiration rate and respiration volume from astronauts in mid-space flight.

The device, known as an impedance pneumograph, utilizes one of the fact that changes in the so-called bioelectric impedance—a measure of the resistance and capacitance across the chest of a human or animal—will have a direct quantitative relation with respiration volume; the amount of impedance rise gives the body inductor and capacitor change in impedance can be measured simply by attaching two surface electrodes, one on either side of the chest, measuring a low-level signal between them, and observing impedance changes on an oscilloscope or pen-chart recorder.

Spacecraft, too, a small impedance bioelectric device that specializes in biological and medical equipment for space has developed one such impedance pneumograph in flight hardware. The device is small and light enough (roughly 1 in. by 2 1/2 in. by 1 1/2 in. and weighing 41 oz.), slightly smaller than a pocket calculator case, to be carried on an astronaut's body, secure in contact with the chest and capable of transmitting back to earth without requiring manual activation on loss. Other companies, including E&M Instrument Co., Houston, Tex., are working on similar devices.

There are several techniques for obtaining respiration rate in flight, including the use of strain gauges in a chest band or a thermistor band in a nosepiece. The latter technique, which is employed in Mercury, is based on moisture changes in the thermistor caused by heating from breath. The thermistor microphone technique is subject to integrated measurements

methods of securing respiration from astronauts, especially where the subject, as in the case for an astronaut, is in suit, remote, ultimate environment, according to Dr. George Sullivan, medical director and vice president of Spacelab.

A spectroscopist is typical of the laboratory devices for obtaining respiration volume. It requires that the subject breathe into a face mask, the volume of respiration causing a displacement of water which is related to volume. For flight purposes, such a device is impractical. In the remote Mercury dash, for example, respiration volume can not be measured, but breath can be measured.

Physicians need respiration volume data, Sullivan explains, as they can tell how well the subject is oxygenating, which is data is necessary for post-flight studies.

There are several techniques for obtaining respiration rate in flight, including the use of strain gauges in a chest band or a thermistor band in a nosepiece. The latter technique, which is employed in Mercury, is based on moisture changes in the thermistor caused by heating from breath. The thermistor microphone technique is subject to integrated measurements

of the subject's breathing rate and or disturbed readings of volume consistently give on it, Sullivan says.

Spacecraft demonstrated the operation of its device using this apparatus as a subject. Electrodes were attached to either side of the chest and the output of its small device (initially a signal conditioner) was fed into an oscilloscope. The output waveform appears as an oscillating sinusoidal wave with frequency and amplitude corresponding to respiration rate and volume, respectively. A large, deep breath appears as a wider and larger pulse than normal pulses in the trace. Similarly, a rapid, deep breath shows as a narrow, high pulse.

## Recent Tests

Heart rate shows up as regular pulses impressed on the curve as heart pneumatic mechanism. An electrocardiogram can be obtained from the by moving the output signal through a separate filter and amplifier.

The device can be loaded if the area is held directly overhead and viewed through a window in the backboard, possibly because of other electronic movement to changes in body position, Sullivan explains. With the area held above and forward of the head,

## 4 GOOD REASONS TO SPECIFY PACKARD FEP TEFLON-INSULATED CABLE

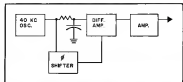
- BUILT-IN UNIFORMITY:** FEP Teflon-coated cable can be extruded in continuous lengths (measuring thousands of feet) without splices. This high temperature insulation is uniformly dense the entire length of the cable.
- 100°F TO -100°F ENVIRONMENTAL RANGE:** Its extreme temperature range makes Packard FEP-insulated cable especially suited for aircraft, missiles, electronics and spacecraft. It maintains its effectiveness at prolonged operating temperatures up to 400°F. Yet it flexes without cracking or dropping at -100°F.
- HIGH DIELECTRIC STRENGTH:** The high dielectric strength of FEP insulation makes it possible to produce cables with unusually small diameters. And it's not affected by, any of the fuels, chemicals or solvents used in aerospace applications. FEP insulation gives this same protection when it's used as a jacket over shielded or multiple conductor cables.
- MEETS MILITARY SPECS:** Packard FEP-insulated cable is made to meet the requirements of the basic military specification MIL-W-16878. And it's available in stock or with color-coded traces.

For complete information on Packard's wide line of aerospace cable, contact the Packard branch office in Warren, Ohio, or either of the branch offices—Detroit or Los Angeles.

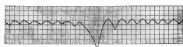
**Packard Electric**



Warren, Ohio  
"The Wire" Division of General Motors



FUNCTIONAL DIAGRAM of impedance pneumograph signal conditions shows body impedance measured by capacitor. Output is suitable for oscilloscope display.



PEN CHART recording of output from impedance pneumograph tested continuously for a 24 hr period on a human subject at the School of Aerospace Medicine, Brooks AFB, Texas. It is typical of waveforms which can be obtained by device made by SpaceLab, Inc. Dip in waveform corresponds to subject deeply inhaling to lie within a dip at completion of difficult psychological test. Heavy dots occurring periodically on the waveform are actually lead voltage pulses caused by heart beat.



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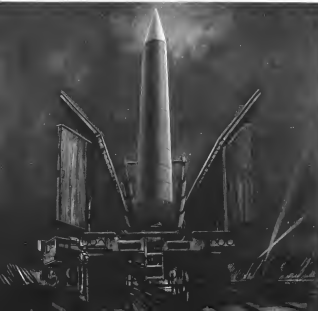
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**IMPEDANCE PHENOMOGRAPH** — two surface electrodes attached to either side of the chest to determine impedance changes from the chest. These changes are related to respiration rate and volume. The light scale signal endoscopes shows heart pulses a current signal, modulated by respiration, suitable for display or telemetry. Device is made by Spectra-Tec, one of several companies developing fuze devices that use other simple techniques for measuring respiration rate and volume of movement.

making nations they might be expected to be checking or adjusting over local control devices, the information continued to come through clearly.

For flight applications, the pilot or astronaut would be calibrated beforehand using the same a-priori conditions and electrodes to be employed on him in later flights. Any significant changes in volume between a preflight control and the record being selected during the flight can then be spotted.

The Spectra-Tec device was subjected to a 74 hr continuous test on a human subject at the School of Aerospace Medicine, Brooks AFB, Tex. A physiological laboratory system, instrumented data obtained from the subject. A portion of the recording, showing an appreciable dip in the waveform as the subject inhaled a sigh at the completion of a difficult psychological test, is clearly visible.

A 48 hr. modulus generates the base center for the phenomograph condition as the maximum impedance change appears to take place between 39 lb and 180 lb. The body impedance forms part of a voltage divider network on which the current is measured. Outputs from the voltage divider detect impedance changes.

A balance adjustment is required to vary the amount of impedance applied to the difference amplifier and correct out match of the divider output, Spectra-Tec unit. This reduces the magnitude of the dynamic range required by the amplifier. If this were not reduced, the company points out, an excessive dynamic range would be needed because of the amount of amplification required to develop a suitable output signal.



Ideas on **space** propulsion



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As an example, around the engine main mount area, Hi-Lok Fasteners were selected for this highly congested structure to overcome extremely tight clearances. Hi-Lok adaptor tooling, fitted to standard air drivers, meets these tough situations with a variety of unusual orbit, extended and back-driving configurations. In some tight places on the A4D-3, only Hi-Lok hand tools can be used, and in several extremely isolated joints, Hi-Loks are installed with improved weldlines.

For the A4D-3's slot punch, the small head of the Hi-Lok acts the minimum counter-sink depth, permitting higher clearances to be designed into thinner gages. The smooth and quiet Hi-Lok assembly results in a controlled polish on clamp-up, consistent in any installed Hi-Lok in any grip condition.

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If space is a problem, use Hi-Loks. If your structure is a pain and many fasteners are required, use Hi-Lok automatic driving techniques. Check your Engineering Standards Group for details.

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6. REUSE THE PIN. 7. REUSE THE PIN. 8. REUSE THE PIN. 9. REUSE THE PIN. 10. REUSE THE PIN.

11. REUSE THE PIN. 12. REUSE THE PIN. 13. REUSE THE PIN. 14. REUSE THE PIN. 15. REUSE THE PIN.

## NEW AEROSPACE PRODUCTS

### Complex-Number Slide Rule

Device is used to calculate complex numbers and formulas in the same way as a standard slide rule for calculations relating to space and clearance problems. The rule operates by adding and subtracting the logarithms of complex numbers plotted on a plane in the way a regular slide rule does straight line number logarithms.



The complex-number rule has two cylinders, one sliding on the other. A gnomon engraved on the outer cylinder is divided into the quadrants of the Argand diagram.

Results can be read off in polar form from the rectangular axis or in Cartesian form from the complex-number axis. Corresponding Argand quadrant is drawn divided above each of the gnomon quadrants. The rule is made of brass and plastic measures 15 in. in diameter and 17 in. long. It is packaged in a gelatinized neoprene case.

Technicon, Inc., 2444 Wilshire Blvd., Santa Monica, Calif.

### Aircraft Fuel Pump

Model 1 pump is designed for pumping fuel injection engines, providing fuel pressure at idling and emergency use.

Features include an adjustable pressure relief valve which is convertible to closed. Manufacturer sets the pump for a capacity up to 30 gals. at 30



psi, using 31/35 octane aviation gasoline. Pump is available with a motor operating on 12 v d.c. at 6 amps or 38 v d.c. at 1 amp. The motor is capable of continuous operation at full voltage. Total weight of the pump is 1 lb.

Weldin Tool Co., 7900 Woodloch Rd., Cleveland 4, Ohio.

### Refueling Nozzle

Aluminum nozzle weighs 10 lb. and is attached to the underside of an aircraft wing for refueling by an aircraft.

Berkens Inc. & Ross Works, 124 E. Third St., Dayton 1, Ohio.



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## WHERE SCIENCE FICTION BECOMES SCIENTIFIC FACT



Place: Hoffman Science Center, Santa Barbara, Calif., where the Advanced Projects Group of Hoffman's Military Products Division is engaged in a variety of original research and development programs. Among these:

- Laser modulation and demodulation. While investigating a variety of approaches, Hoffman scientists have conceived an original technique for direct quantum electronic modulation.

Hoffman researches how to use laser communication for future orbiting space stations. (Photo shows contemporary study in 1/20" length to 1/2")



This and others are being developed in prototype, aimed at application to point-to-point communications.

- Economical solar power supplies. To meet the increased power requirements of large spacecraft, Hoffman Science Center is investigating a variety of techniques and materials. These promise greater efficiency, reliability and flexibility from lighter-weight solar power supplies for future orbiting and planetary space stations.

- Solid-state traveling wave devices. Hoffman scientists are using the piezo-electric properties of gallium arsenide to develop dc power conversion devices. Their goal: improved efficiency for systems in a wide variety of fields, including ASW.

- The men of Hoffman's Advanced Projects Group are converting science fiction into scientific fact. They lend strength to, and gain strength

from, the Military Products Division's extensive background in communications, reconnaissance, navigation and surveillance systems and devices.

Close proximity of transmitter and receiver antennas enables Hoffman research team to solve by creating wide dynamic range of its own, using scientific fact, communication in space orbits.

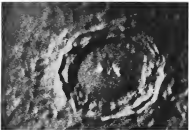


**Hoffman**  
ELECTRONICS CORPORATION  
Military Products Division

2102 South Grand Avenue, Los Angeles 7, Calif.



Here photo-optical tracking telescope was used to take moon photo above. Arrow points to sister Copernicus. Cleanup of Copernicus, shown in photo below, was taken with Air Force's TV telescope.

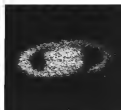


## Satellite Tracker Utilizes Television For Image Clarity

Air Force Missile Test Center is testing a satellite and missile tracking system which combines a 24-in. aperture astronomical telescope with a television image cathode system replacing the conventional photographic recording system. USAF says the TV system permits clearer exposure with less image motion caused by atmospheric turbulence than a photographic system, with resulting reduction of distortion. The planet pictures above were taken to test the TV telescope tracker, and have produced sharp detail as good as the best astronomical photos available, according to the AFMTC space tracking group. Photo at right, taken at Patrick AFB, shows the 25,000 ft. telescope antenna tracking a missile launched from Cape Canaveral, Fla., 25 mi. to the north.



USAF's television telescope views Jupiter (above), bringing planet's bands into clear view. Photo below shows rings of the planet Saturn.



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**the ARMY MOHAWK  
does it all in just 600  
feet of cow pasture!**

The Grumman AO-1 Mohawk is a twin turbo-prop aircraft designed for electronic surveillance and observation missions. It features short-field capability for maximum operational flexibility. It's an all-weather craft—when the birds are grounded in snow, ice, or mud, the AO-1 will complete its assigned missions. The MOHAWK configuration offers: • short-field takeoff and

landing • operation from unimproved areas • good low-speed control • drop task and supply pod capabilities • adaptability to various types of photographic and electronic equipment.

Long a producer of reliable aircraft, Grumman now also develops new concepts in electronic systems integration, missiles, and space vehicles.

**GRUMMAN**

AIRCRAFT ENGINEERING CORPORATION

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HUGHES SYNCOM COMMUNICATION SATELLITE will have payload antenna which will scan 10-degree arc in which plane of each element is controlled to produce pencil beam with variation of phase of satellite spin rate to keep beam aimed correctly.

## New Telemetry Multiplex Idea Proposed

By Philip J. Kline

Washington—Fundamentally new approach to telemetry multiplexing, with promise of important advantages over presently used time and frequency multiplexing for some applications, was revealed here during the recent National Telemetry Conference.

Telemetry is known as "orthogonal waveform multiplexing." It was reported by A. H. Balluff of Aeronautical Electronics Co., Washington D.C., a recently formed company working in the instrumentation field.

In comparison with frequency division multiplexing, the new technique has the advantage that it requires only a single oscillator, eliminates the need for filters, earth-to-space induction, and permits bandwidth saving by reducing the guard band spectrum demand.

Compared with time division multiplexing, Orthogonal permits use of a simplified type of automatic synchronization and eliminates the possibility of time slippage. Additionally, it is in some ways less time division multiplexing in its channel capacity which can be expanded widely by adding extra antennas, Balluff said.

During the opening and closing period following Balluff's report, a National Bureau of Standards scientist called the new technique "extremely intriguing."

In other papers delivered at the National Telemetry Conference, the following advances were reported:

- **Ultra-bandwidth compression** ranging from 70:1 to as much as 800:1 appears available by using a small data processor aboard a satellite/spaceship vehicle to scan the data scheduled back to the ground station, which have undergone a significant change from previous values. Studies of telemetry tapes reveal that more than 95% of the data is non-informative but is scheduled to be sent; consequently the use of data significantly from previous data, John A. Hulse and Chulian forecasts with Lockheed-Mosley and Space Co., now with Fairchild Semiconductor Corp., co-authored the report with Richard A. Schenck of Lockheed.

A small vehicle-borne data processor capable of analyzing 10,000 samples per second to determine which data from previous measurements be scheduled to transmit; should weigh less than 10 lb. and consume approximately 10 watts of power. Hulse said, using a computer simulation run. The technique called "data compression" could provide bandwidth compression of 50:1 to 90:1 in high activity type measurements in a 1% tolerance system, or approximately 400:1 compression in low-activity measurements, with corresponding increase in time saved power levels. The processor would be designed so that the threshold level for data transmission can be set

independently for each channel and so that the levels can be changed by command from terrestrial stations.

- **Ultra-broadband telemetry antenna**, capable of providing approximately 12 db gain over the frequency range of 130 mc to 3,400 mc, to accommodate the coming shift of telemetry from VHF into the microwave region was described by John D. Dwyer of the University of Illinois. The antenna consists of a modishly patterned array of four conical-horned elements. Dwyer said the University of Illinois, under contract to the USAF's Aeronautical Systems Division, has constructed a conical conical horn antenna which has been tested over the 400 mc. to 4,400 mc. band. It provided beam widths of 45 to 55 deg.

- **Antenna-mounted down-converter**, which can be used to adapt present VHF telemetry systems for use in the new 2,200-2,800 mc. telemetry band, was reported by Walter L. Winter of the Naval Aeronautics Facility. The down-converter consists of a low noise (4 db) noise source, a computer simulation run, a 2,22.5 ghz. broadband filter ahead of the mixer. The existing VHF telemetry receiver then becomes, in effect, an intermediate frequency amplifier at a double superheterodyne system. Use of a low-noise parametric amplifier as the down-converter would improve system performance, Winter indicated.

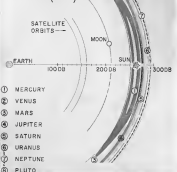
• **Pre-detection data recording** in an intermediate frequency can provide increased accuracy and greater flexibility in accommodating different types of telemetry formats. Len Riley of Dynatronics and Owen J. Ott of Data-Central Systems reported in separate reports. Ott commented that while a properly designed pre-detection recording system provides data accuracy equal to or better than conventional post-detection recording and can handle more different types of telemetry formats, some characteristics of system components which would have no consequences for post-detection systems will adversely affect pre-detection systems. A low-channel pre-detection system which Data-Central Systems built for Lockheed used a mixer frequency of 700 kc for recording and demodulation, Ott said. An important potential advantage of pre-detection recording, Riley said, is the possibility of using modulation techniques to recover weak signals which otherwise would be lost in noise. However, before this potential can be realized, experiments are needed in the hardware stability of the record to produce histograms, he said.

- **Adaptive digital telemetry system**, using one of several ground-to-vehicle feedback techniques shows considerable promise of improving system performance and reliability, according to a report presented by Bernard Hines and R. C. Sorenson of New York University. The most promising of several feedback techniques investigated is one called "double domain feedback." Using this technique, a space vehicle would transmit only a half message, then pass to base from the ground-based telemetry station as to the quality of the signal received. If an acceptable signal is reported, the vehicle would proceed with its next message; if not, the signal source would be reported to the base. The message transmitted before each pass would depend, in part, upon time of the signal, a function of vehicle distance from the terrestrial station. For short distances, the vehicle might transmit only a single digit before waiting for confirmation, while at larger ranges a single transmit a number of digits to ensure overall loss. However, if the first three received out of acceptable quality, the terrestrial station would interrupt the vehicle message.

- **Standardized models and subsystems** allow a promising means of achieving the extremely long life and high reliability required for deep space probe vehicle system projects. Fred M. Huddle of Jet Propulsion Laboratory said. Such standardization would make it feasible to reuse successful engineering efforts in making early "weather-vane" designs and in 1965 to find suitable components.

## COMMUNICATION LOSS IN DB AT 2300 MC.

$$L_s = \text{LOG}_{10} \left( \frac{4\pi d}{\lambda} \right)^2$$



SOLAR SYSTEM DISTANCES are shown by a communications engineer from a new orbiting earth as expressed in decibels of attenuation at 2300 mc. Chart was prepared by National Aeronautics and Space Administration's Jet Propulsion Laboratory.

Space Administration's Goddard Space Flight Center to enable the agency to minimize a unit tailored to a specific space mission from viewpoint of efficiency, as described by NASA's F. T. Cole, II. J. P. Cole and C. F. Rice. The research group, approximately 4 lb., measures 75 in. in diameter, and consumes only 4 watt in the most rapid and 14 watts in the playback mode. The selection of components and modules, a recorder with the desired type speed, frequency response and other required characteristics can be quickly assembled.

- **Director antenna for spinning satellite**, such as a communications satellite in a synchronous equatorial orbit, which requires no moving part around the vehicle was described by Harold A. Rosen of Hughes Aircraft Co. The technique is a more advanced version of one which will be used in the NASA/Hughes Sonnet communications satellite. Sonnet will use an antenna that produces a figure-eight radiation pattern which sweeps out a star-shaped radiation pattern in the arc of the orbital



# NEW PD HELICAL MEMBRANE AIR DIELECTRIC COAXIAL CABLE



**Fast propagation, low signal loss and high temperature resistance—all in one efficient, lightweight cable!**

PD Helical Membrane cable marks a new step in the state of coaxial cable art for missile, missile launching and atomic energy instrumentable applications.

It combines all the outstanding advantages of PD air dielectric coaxial cables—low attenuation, excellent frequency response, uniform electrical properties over wide temperature variations and unlimited operating life—with even greater speed of propagation and, when used with a Teflon® hose, higher heat resistance.

The inner conductor is coaxially supported by a polyethylene helix within a commercially pure, seamless aluminum outer conductor. For applications involving

high temperatures (100° C. 250° C), PD Helical Membrane cable with Teflon® substituted for polyethylene is ideal.

PD Helical Membrane cable of 50, 75 and 300 ohm impedance is fabricated in 1000-foot continuous lengths and in standard sizes of 1/8", 5/16" and 1" diameters; other sizes from 1/4" to 1 1/2" in order. Complete cable systems, including attachments and connectors, are available. Your Phelps Dodge representative will be glad to give you additional information. PD Helical Membrane cable is made by Phelps Dodge Copper Products Corporation at Yonkers, N. Y.

**PHELPS DODGE ELECTRONIC PRODUCTS**  
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of cables at each frequency. Another example may be of non-overlapping pulse signals within a brief period or comparing all pulses.

Particular electrical advantages and in the new technique are those which are polynomial functions of time—those which can be expressed as finite sums of algebraic terms each of which is some power of time.

As Colquhoun points out, the new method is a matched filter correlation process to separate the signals and to recover the information in each channel. The fact that the carrier and orthogonal carriers

are common controls between channels. The experimental system built by Bell and Electronics demonstrated a main trunk together with 40 ch. channels. To achieve such a system and, additionally, it is such a system, to meet not an unmodulated reference signal over one channel, he noted.

In response to a question from the floor, Bell noted that there may be a practical upper limit to the number of channels which can be provided, because of the increased amount of integration required for each added channel.

## British Developing Concentrated, Depressed ILS Localizer Beam

**London**—Adoption of a beam receiver to the Standard Telephone & Cables Stan 7 beam receiver has depressed approach beam to 25 deg. above the horizon, significantly reducing possible interference by crossing aircraft.

Thinking now it could use, at Heath Airport to project the system toward ICAO Category 1 performance, capable of full automatic guidance in an automatic landing system. Improved ILS would be allocation of the beam cable system now under test by British Road Landing Experimental Unit at Bedford, and Federal Aviation Agency at Atlantic City, N. J.

By adding the beam collector, STC team led by F. H. Taylor has concentrated the beam into its first lobe, substantially reducing ILS radiation above the 25 deg. angle. Recently, the unmodified Stan 7 lobe reached an elevation of about 50 deg.

In addition to reducing radiation

from crossing planes, the modified unit produced a more efficient aerial system which requires less power from the transmitter. Taylor and colleagues are that fully transatlantic equipment is possible.

STC has integrated its receiver and clearance aerial arrays into a single bank unit, with the clearance aerials mounted on top of the receiver, rather than a separate unit behind the receiver (AW Aug 5, 1960, p. 78) as now in use at London (Heathrow) Airport.

Under test and proposed to eventually decrease the all-around clearance area from pattern, and to provide a narrow cone beam with a 20 deg. clearance beam. Thus guidance into the ILS pattern would be obtained from the receiver VOR beam.

Technicians are now working on doubling the aperture of the cone array from the present 35 ft to 170 ft.

This will produce a cone through defined beam in several pencil beams that forward will be the optimum for ICAO Category 1 approach. STC claims that bending of the cone radiation pattern due to reflections from nearby objects will be reduced to the absolute minimum.

Another technical project centers on glide path equipment to replace the radiation pattern beam in elevation and azimuth. STC holds the idea that the new used in the ILS test program.

Modified beamers are 35 ft long and 15 ft high, about 4 ft 6 in. higher than Stan 7 units now in use. It is designed to dissipate all shock by a few things usually but will meet high wind velocities and have some loading.

To date, four Stan 7 (unmodified) ILS stations have been installed at London (Heathrow), two at London Gatwick, one at Manchester, one at Teesside, one at Bournemouth, one at Manchester Airport, and one at Royal Aircraft Establishment, Bedford. Systems are also under construction at Farnborough.

All these are the Stan 7/3/9 system, comprising a dual beam beam (Stan 7) for azimuth, glide path equipment (Stan 9), and carrier beam (Stan 9). System, installed under \$4.2 million Ministry of Aviation contract, meets ICAO Category 1 and 2 requirements.

## IMPROVED FILTER CENTER

**Improved Ruby Loss on Resonance**—Significant increase in efficiency of ruby lasers is expected in the near future when greatly improved ruby crystals become available. Lunda Co., major producer of rubies for laser use, expects to reduce internal scattering, caused by impurities, by factor of 10.

**Pin Air Station Inertial Guidance**—Inertial guidance and its possible application to airline navigation for operations over water and over land masses which do not have ground-based aids, is under study by Pin Airline World Airways engineers, in cooperation with the Federal Aviation Agency.

**Flight Rate Receiver Control Proposed**—Simple, lightweight system by which a specific radio receiver is controlled directly based on direct measurement of rate of change in altitude due to frequency rate of change, was proposed by J. S. Dabrowski of NC Spitz Prop Division of General Motors in the recent National Aerospace Electronics Conference in Dayton. Primary inputs to the system



**MODIFIED STAN 7 LOCALIZER** array at Heath Airport integrates both receiver and clear array units for sharper definition of approach in automatic landings. Clearance aerials are the three circular dishes at center.

## M.I.T.—Raytheon science team hits moon with light from powerful Raytheon laser

On the night of May 9 last, a team of scientists from the Massachusetts Institute of Technology and Raytheon scored an impressive electronics first—bating with a beam of ruby light a mountainside area southeast of the crater Altiplano, on the surface of the moon. Proof came within 3.6 seconds following each of 13 successive hits, when the reflectivity of the light returning back to the earth was recorded on an oscilloscope. To rack up these historic billfives, the research team called on the most brilliant coherent light source yet developed—a powerful new Raytheon laser.

Unobscured lightwaves spread out,

low intensity as they travel. But with the "right" focusing action of the laser (a light amplification system), it is now possible to generate and project a needle-sharp shaft of light—many times brighter than the sun—in a straight line over great distances. A mile on the moon, in the area illuminated, would have had no difficulty in recognizing that fact that someone on earth was signaling to him. The light, after its 238,855-mile trip, was still as bright as a flashlight bulb.

Raytheon was among the first to develop an operating laser, and has been a pioneer in new laser concepts. Future lasers promise to lead

themselves to military applications and to new techniques in communications, radar, medicine, space vehicle guidance and control, fabrication and processing, and a host of other still unknown uses for the benefit of man. This is Raytheon research and development at work, serving business, industry, science and defense. Can Raytheon electronics help you? Raytheon Company, Lexington, Mass.

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### Advanced Researchers—

## The sky is not your limit



The Advanced Development Laboratory of Raytheon's Surface Radar & Navigation Operation (Boston) seeks additional skilled and imaginative technical talent. Advanced Systems Engineers and Physicists for the field of free-space, non-laser, specular research that led to laser's spectacular omniscient vision.

Our prime function is exploring and developing electronic capabilities in addition to the challenges laser program typical Advanced Development Laboratory projects include: Directed Filter Generation Systems, Translational and Experimental work on Spherical Mirrors, investigation into High Level Microwave Energy Absorption by Gases, techniques for extracting information from raw signal data.

Your qualifications are carried to a point where opportunity exists for one of the Engineering Departments to embark on delivery of the data. The results of your participation in such projects will frequently be of sufficiently high level to warrant publication.

The Laboratory provides sufficient assistance from service groups to enable you to pursue theoretical and experimental work free from the problems of production, administration and tape. The well-equipped experimental facilities include a computer in full-scale service.

If you are qualified and would like to join this select group of key technical personnel, please forward your resume to Mr. William Gallagher, Management and Professional Recruiting, Department 128, Equipment Div., Raytheon Co., P. O. Box 520, Waltham, Massachusetts.

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would come from vehicle data, weapons and sensors, supplemented by a laser sensor, vertical guidance. Pilot would maneuver to maintain skin temperature rate within prescribed limits. The entire control system would weigh about 50 lb and consume no more than 15 watts of power. Dubois's criticism: Excessive analog amplification and digital computer studies of the proposed non-perturbative rate flight control system have been conducted, he said.

▶ **Area Coding Cuts TV Roadwidth**—Channel competition ranging from 4.1 to 23.1 on the television dial is being reduced, says a new study by the Federal Communications Commission. The study says that by using a new technique known as "Area channel coding" developed by Philco Corp. under an Advanced Systems Research Corporation grant, the FCC report estimates that non-Federal television channels could be reduced to 10 channels. A September of Philco and Robert L. Rosen of ASD, represents an escape in terms of best ways to allocate channels and to allocate bandwidths, including individual channels or larger areas of elements of channel bandwidth.

▶ **Optical Superlat Near Test—Standard**—Two earth will soon begin tests in which two laser optical beams will be heterodyned to produce an intermediate frequency at the microwave region. This will open the way to use of laser for a practical communication system by modulating the output of one of the lasers. Dr. A. E. Siegman of Stanford told the recent National Acoustics Electronics Conference. Earlier Stanford systems used a single sub-milliwatt heterodyne produced by two different wavelengths among the noise present in a laser's output. The laser beam was dissipated by directing it against the cathode of a cross-waveguide wave tube which functioned as a photomixer. This produces an intermediate frequency in the microwave region, which was then amplified by the traveling wave tube. Stanford is now producing a modified version of a TWT with more sensitive photomixers which is commercially available for such applications, Siegman said. He added that Stanford's work in laser modulation and demodulation has advanced to the point where the accurate would like to work with system engineers to obtain guidance in designing work toward development of devices they need.

▶ **Small Probe Costed on Microcircuit—Avionics** equipment manufacturers whose annual sales average \$10 million or less may find it was to meet the popular demand to use up in laser wave circuit manufacturing capabilities. P. E. Haggerty, president of Texas Instru-

ments and president of the Institute of Radio Engineers and of the recent National Acoustics Electronics Conference in Dallas, Haggerty, whose company is a major supplier of microcircuits, said that the cost of an on-board facility with required capabilities to meet high quality output was not economically justifiable. The investment for smaller equipment manufacturers, Haggerty said, Texas Instruments has achieved more than \$10 million in semiconductor production mechanisms in the last few years.

▶ **Capacitor Reliability Churn—Spring**—Electric reports it has topped its lifetime mean reliability objective of a failure rate of 0.001% per 1,000 hr on solid tantalum capacitors by achieving failure rates of 0.0004% per 1,000 hr, with a 68% confidence level.

▶ **First Digital Flight Simulation—Digital** computers have modeled one of the first analog, computer-aided, actual flight simulators with an Analogized Systems Division contract to Rank, Division of General Precision for two C-119 jet transport digital flight simulators. Link into their side the first digital flight simulator to an digital computer. Contract award is expected to total more than a million dollars when made final.

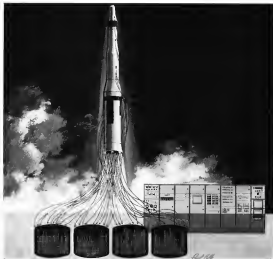
▶ **Electronic Industry Pitches Growth**—Increased competition in the electronic industry is reflected in figures on growing business failures during the past year. Total of 16 electronic companies failed in 1967, an increase of 17% over previous year, whereas total failures for all types of business fell only 10% over 1966, according to figures released by Electronic Industries Assn.

▶ **Super-sensitive IR Detector—Infrared** detectors, which is said to be 10,000 times more sensitive to infrared radiation than previously available units in the one to five micron region, has been announced by Massachusetts Institute of Technology. The device uses an infrared semiconductor crystal, cooled to a temperature of 77K. Detector output is 1,000 volts per watt of 500K black body radiation. Detector is being produced by Honeywell's cryogenic facility at 1945 Ansonway, West Los Angeles.

▶ **Fast Warmup Tubes Developed**—Ceramic moving tube which becomes operational within 1.3 sec after heater power is applied, compared with the 11 sec required by warmup of conventional glass tubes and 25 sec for conventional ceramic type tubes, has been developed by General Electric's Recovering Tube Dept., Chesham, Ky. The rapid warmup is achieved by use







## AT RADIATION, CHALLENGE IS OPPORTUNITY

*Example: Advanced data systems to speed Minuteman*

Minuteman's real place is a 352 channel/mal of telemetry information for instant visual analysis by test crews. The high/low-level PCM multiplexing system—designed and produced by Radiation Incorporated—is representative major advance in data-handling techniques. It is packaged in less than a cubic foot of space, processes analog signals, and will yield maximum performance data from each test firing.

Radiation also developed checkout instrumentation to convert Minuteman's 352 telemetry channels into display form for real-time analysis by test crews. And, the company produced four complete ground data-processing facilities to monitor and relay information from all digital telemetry and guidance equipment.

Radiation's scientists and engineers have entered the age of satellite instrumentation with competence in data acquisition and processing for aerospace and range instrumentation.

Nimbus, Teller and QAD will utilize Radiation's proven PCM techniques for long life operation in cold for in space environments.

Become a part of this challenging space electronics program. We are currently seeking experienced engineers in the design and development of high speed airborne and ground digital/telemetry data systems at either individual contract or project engineers. Send us your resume or write for details. Director of Data Systems, Dept. JMW42, Radiation Incorporated, Melbourn, Fla. Radiation is an equal opportunity employer.



Communications systems • Data acquisition and processing • Automatic checkout • RF systems • Manufacturing

## MEN OF MARS

## ENGINEERS AT ASTRONAUTICS 'ORBIT THE EARTH'

In this mockup model of "MARS"—Manned Astronautical Research Station—engineers are making simulated space flights at General Dynamics/Astronautics in San Diego, California.

The MARS vehicle, placed in orbit by Atlas Centaur (also designed and built by Astronautics) could take three astronauts 200 miles into space for almost a month of scientific studies.

MARS typifies the advanced planning and technical resourcefulness that have made General Dynamics/Astronautics an ideal association for space-minded engineers. We're also at work on such Atlas Centaur programs as *Mariner*—a deep space probe to the vicinity of the planet Venus—and *Surveyor*, which will soft-land an instrumented package on the moon.

Atlas Centaur is the free world's first space vehicle to be powered by liquid hydrogen. It not only opens our entire solar system to research, but creates extraordinary opportunities for engineers who look beyond the present state-of-the-art—men who are somehow not content with the status quo.


*If you're that sort of man, we urge your inquiry. It entails no obligation, of course, and may prove to be of tremendous mutual advantage. Use the attached Professional Inquiry Card, or write in confidence to Mr. R. M. Smith, Manager of Industrial Relations Administration-Engineering, Department 220-96, General Dynamics/Astronautics, 5743 Kearny Villa Road, San Diego 16, California.*



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**"IF AT ANY TIME a module fails in actual service due to defective parts, workmanship or packaging, Enginereed Electronics Company will repair or replace the module without charge provided required parts are still available."**

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exhaustive effectiveness of direct radar control launched from the inside in flight. The test of these tasks is expected to lead to improvements in U. S. missile design and anti-missile discrimination system.

- Monitor manned space launches at all element links in the world wide chain of tracking stations which are used to follow U. S. returned orbital flights.
- Provide 24-hr. monitor of all laser probes.
- Furnish technological information to
- Evaluate anti-missile defense systems such as the Navy's Polaris.

The radar antenna, weighing approximately 1.5 tons, was designed to permit edge detection of more than 10 m. from front, side or ship motion. It is a C-band radar with a Cassegrain reflector.

Studies have been conducted to ensure that the antenna and barrels, like a resonant frequency greatly deficient from the vibration frequency, cannot be ship projectile action to prevent our pathologic vibration damage to the radar.

The mobile range stations are to be equipped with an integrated radar antenna designed of C, L- and S-band tracking and data receiving capabilities. The Chaland trailer is an outgrowth of Sperry's AN SPG-56 guidance radar for the Navy's Talos missile and has gun ranges on its 30 ft. mast to provide line-of-sight stabilization.

Tracking data will be converted for roll, pitch and yaw of the vessel against measurements obtained from the Ships Inertial Navigation System (INS). Angle and range data are obtained on a primary and two secondary targets simultaneously in real time.

The integrated tracking system will incorporate control consoles, radar, radar built indicators, secondary indicators, error monitors, warning device and built-in testing apparatus.

#### Telemetry Equipment

Telemetry signals from the mobile target will be received through a second antenna. Pre-detection steering is vital, and the recorded signals will be retransmitted over a third communication antenna to a recorder on a cargo aircraft and flown back to Cape Canaveral for analysis. The ship's equipment will permit receipt, transmission and decoding of all standard modulation techniques.

Telemetry antennas can also be used in radio direction finding in searching for beacon-equipped sea mines or in ocean packaging. The telemetry system has multi-channel capabilities, central console, training simulator equipment and testing gear.

The "couple" SINS systems will be periodically checked and oriented through the use of a telescopic sextant device located above the bridge which will automatically compute star fixes.



**TRANSMISSION TOWER** on Sperry test range includes two antennas which track targets at the MAES Chaland radar antenna to transmit the latter probes and test it for gun, beam and side lobe levels. Following tests, antennas will be shipped to Honolulu for installation aboard one of the two MAES ships.

Timing system on the airborne tracking station will receive ASIR "off-line" from a system at the Cape which is synchronized with time at the U. S. Bureau of Standards. Time signals received by the ship are converted to be accurate within 10 microseconds.

Signals from the Naval Observatory Station WWV will be to be used in synchronizing the ship's clock.

#### Computer System

Data processing center for the ship environment system will employ a Corvus 1206 computer designed for shipboard use and controlled, the same type of computer as the one now being installed at the station on Accuscan (Shaw).

The 1206 computer will have to rely upon input/output capabilities, capacity of 32,000 words and algebra to power standard telephone communications.

The two vessels will be equipped to handle voice, teletype, digital data, aircraft and harbor communications and dual telephone communications. Radio communications will be possible over HF, VHF, UHF and NLF bands.

All tracking and target data is to be recorded primarily in digital form, including ship's attitude and position. All records will have time codes and rapid response allowing for later correlation.

The operations control center aboard each ship will monitor and control ship and environment activities. Handling these centers on the vessels will be ship operators and technicians equipped with access to status boards and target trajectory plots.

Each ship is 52 ft. long with a 72 ft. beam and will have a sustained sailing speed of 17 1/2 kt. when not engaged in tracking exercises. Personnel aboard will include 100 crewmen and 100 air environment specialists.

#### Associated Companies

Other companies associated with Sperry Rand Corp., Sperry Gyroscope's parent company, in the MAES project are: Bethlehem Steel, ship construction and maintenance, Gibbs & Cox, Inc., marine architecture and supervision of ship construction, and TET Federal Laboratories, telemetry and timing gear, communications and meteorological systems.

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- Chamfered ends
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- Full range now material on hand

#### TAPER PINS

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- Stainless 18-8, type 303. Also many in type 316 (General Information)
- Size: .002 through .005 inch
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# RENDEZVOUS ROUTE OR COLLISION COURSE?

## A QUESTION OF SUPREMACY.

Pilots of U.S. Navy fighter planes will shortly be able to rendezvous or fly in formation with greater security under a wider range of conditions. For they'll know exactly how far they are from each other. ■ Air to air ranging will be added to the present TACAN sets with the General Dynamics/Electronics—Rochester SC-704 modification kit. No bigger than a "best seller" lighter than the circuits it replaces, it permits as many as 16 planes to judge their distances from a sixth each as a group leader or air tanker. Convex or linear? Negligible—only 3 feet hooves. And the SC-704 actually improves the

reliability of the air to ground linkages of the TACAN system because the vacuum tube electronics is replaced with silicon, completely solid-state radiation. ■ Precision air to air and missile guidance ranging equipment comes naturally to a division of General Dynamics where the B-66 Hustler and Atlas ICBM were born and bred. General Dynamics/Electronics—Rochester is today's supplier of advanced ideas in the technology of navigational equipment and radar beacons. ■ Every product we make started with a question: *What do you really want?* Wrote 1408 North Goodman St. Rochester 1, New York



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## Dassault Spirale 3 Transport Design Shown

Model shows design details of Airbus-Dassault's new transport Spirale 3 which won recent French air fair competition for a small transport aircraft (ENR Feb. 18, p. 41). Foreplanes are two Turbomeca Turmo 30 engines developing 1,200 hp on shaft.

is being produced at a rate of three to five aircraft per month. Since the first piston engine prototype was introduced at the 1977 Paris Air Show, a total of 12 have been built. Eleven of these were sold to domestic users plus one each in Finland, Sweden, Holland, West Africa and Iran. Four have been sold to West Germany and five in Nepal. French customers have an option to order 42 of the remaining 100, the company says. For the Dassaults, the company sees three to four construction projects and others in the next six months.

In addition, Pater is working on the development of orders for two standard Porter fitted with a supercharged 140 hp engine.

As an alternative, it has opted for two standard Porter fitted with a supercharged 140 hp engine.

HAAS piston engine and seven Turbo Porters with the Airtron 2 510 vhp (supercharged). Seven of these will go to Alaska, the remainder to Asia and the Middle East.

Last June, the company was granted certification for an increase in takeoff weight of its supercharged 140 hp engine from 5,075 lb to 4,533 lb, which resulted in increased performance.

Like the Aermacchi Lockheed 80, the Porter can be converted to a wide range of duties, including transport of cargo loads weighing up to 1,100 lb. In standard configuration, it can carry seven passengers plus pilot.

In addition, it is being used for aerial photography and survey work, crop spraying, with a normal spray tank capacity of 550 U.S. gal. Under Federal Aviation Agency CAR 4 rules, basic up to 267 gal can be carried if required.

It also can be used for supply drops and parachute training.

Sweden's Sisu Aircraft Co., agent for the Pilatus PC-6 Porter in Scandinavia, is currently testing a special amphibious version of the Porter with floats from its Fido Corp.

## Sailplane Exhibit

The Harrier exhibit also included three sailplanes shown here for the first time. They were:

- **Garff 1b**, built by Ernst Heinkel Flugzeugbau GmbH, a high-performance sailplane vehicle with a slender-wing construction, which flew for the first time in December, 1980.

• **Garff 1b**, a lightweight and strong standard class powered version fitted with a BMW Type 3216 small turbojet engine with a takeoff thrust rating of 131 lb, also being constructed by Heinkel.

• **Porter MS-60** high performance powered sailplane with retractable landing gear and automatically folding propeller, fitted with a 50-hp two-cylinder (L.O.) engine, built by Airbus Porter KG, Flugzeugbau of Bern. Company also builds the Porter Flote two-seat, single-engine sport aircraft (ENR Mar. 2, 1980, p. 171). Large numbers of Flotes have been ordered by the West German Defense Ministry for training purposes, and others are in service with West German sport clubs. Developed in conjunction with the

## Aermacchi Lockheed 60

(260 hp, T580-T580 Constant speed engine)

### Weights

Empty weight ..... 2,180 lb  
Useful load ..... 1,600 lb  
Takeoff weight ..... 3,780 lb

### Performance

Maximum speed at 11,500 ft ..... 161 mph  
Cruise speed (75% power) at 13,100 ft ..... 141 mph  
Takeoff distance over 50 ft altitude ..... 5,000 ft ..... 1,520 ft  
Landing distance over 50 ft altitude ..... 5,000 ft ..... 1,520 ft  
Range ..... 1,900 mi  
Endurance with reserve fuel ..... 4 to 30 min, on reserve fuel

## Pilatus PC-6 Porter

(New specifications with standard 140 hp CSO-418 BME) (Epoxying engine)

### Weights

Empty weight ..... 2,160 lb  
Useful load ..... 1,875 lb  
Takeoff weight (maximum) ..... 4,035 lb

### Performance

Cruise speed at 40% power ..... 6,700 ft, no load wind 115 mph  
Takeoff distance at sea level ground run approx. 515 ft to clear 50 ft obstacle ..... approx. 550 ft  
Landing distance at sea level ground run approx. 150 ft over 50 ft obstacle approx. 750 ft  
Range at 7,800 ft, 60% power ..... 150 mi  
Endurance ..... 6 to 30 min



# Lamtex Progress In Reinforced Plastics:

## A VITAL FACTOR IN SPACE AGE TECHNOLOGY

An important though undervalued American triumph in the space era has been the success achieved in developing new materials to shoulder the critical burden of structural materials. Lamtex Industries, Inc. has been in the forefront of this development, making significant contributions to the state-of-the-art of modern reinforced plastics. Advanced Lamtex research, processes and equipment have led to the development of rigid material design alternatives by providing optimum quality reinforced plastics for critical tasks in space, military weapons systems, automobiles, and to meet the more varying demands of industry.

Lamtex reinforced plastic products outstrip ordinary materials by any measure. Compared to steel, for example, HYSTRAN—Lamtex's exclusive filament wound reinforced plastic—weighs half as much, has a strength-to-weight ratio 25% higher, and cuts R&D, tooling and production costs by more than 50%. As much as two years' faster delivery can be made of Lamtex HYSTRAN rocket engine cases than of steel cases. If you're looking over, also add these advantages resulting from the use of Lamtex reinforced plastic: superior thermal and electrical insulation, greater resistance to corrosion, impact and shattering, the safety of being non-magnetic and non-sparking, freedom of batch sensitivity problems, wider versatility in choice of size and shape.

As before a leader in its field, Lamtex offers the broadest line of high quality reinforced plastics. HYSTRAN filament wound structures are robust design and minimal problems previously considered impossible or highly impractical. Lamtex's Custom Molding Facilities are capable of producing parts and assemblies in a wide range of sizes, shapes, and cross-sections by blow-molding, extrusion, and Vacuum Bag processes. "Sheet" HYSTRAN is a unique new material combining the shape flexibility of molding with the strength characteristics of filament winding.

Some of the major space, military and commercial projects currently using Lamtex reinforced plastics include: MATTHEW, IMPULSER, POLARIS, FREIGHTER, ECART, ROMARK, RANGER, NIKE-ZEUS, VORTAG, DISCOVERER, BOLT, LAW and a variety of NASA projects.

Whether your material problem involves weight, stress, temperature, corrosion, insulation or any combination of these factors, Lamtex reinforced plastic can probably help you. Complete technical and cost proposals will be submitted without obligation—we have even produced actual product samples to prove that "it can be done by Lamtex." Why not let us prove it to you?

LAMTEX INDUSTRIES, INC., Farmingdale, L.I., New York

# LAMTEX



7-FOOT LAMTEX CASE



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AND ASSEMBLIES



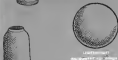
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BLOW-MOLDED  
VESSEL



ROCKET ENGINE CASE



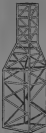
LAMTEX FILAMENT  
WOUND PRESSURE VESSEL



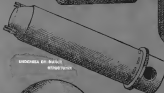
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in a conventional manner, to add and return to use. Two propellants are being developed.

One is the advanced liquid or gaseous (LAGE), which uses liquid oxygen and liquid air as fuel. Air would be added during flight in the thrust plane, compressed, cooled and injected by the liquid hydrogen, and then burned with the hydrogen. This program would demonstrate the feasibility of this concept.

Going further into this concept, the second development area involves an approach to separate the liquid oxygen and liquid hydrogen. The liquid oxygen would be stored for use in flight outside the atmosphere. The liquid hydrogen would be pumped onboard. Some hydrogen could be used as electric propellant; others were intended for electrolytic flight.

#### **Supersonic Flow Research**

The first related program would lead to the dissemination of a supersonic flow concept. Present data indicates and suggests the flow of air in various speeds as it enters into the burning chamber. If the principle could be demonstrated, engines with greater performance than any now being built would be under way.

A combustion tunnel-race engine in the fourth development area. Up to Mach 8, the engine would act as a conventional engine. The higher speeds the inlet would be closed off and liquid hydrogen and liquid oxygen would be injected into the burning chamber, producing a rocket type of thrust through reaction. One company has already demonstrated such an engine. The next step involves the need to simulate hypersonic speeds in the atmosphere and design rockets, which be demonstrated. The Dyno-Sonic head-on vehicle will demonstrate most of the principles in this area.

#### **NASA Contracts**

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

##### **RESEARCH AND DEVELOPMENT**

**U.S. GARY, California**—A \$1,000,000 contract for the development of a supersonic engine. The engine will be used in a hypersonic engine.

**Wallops Island, Virginia**—A \$1,000,000 contract for the development of a supersonic engine. The engine will be used in a hypersonic engine.

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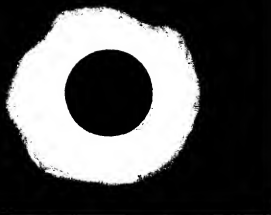
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most in medicine, or indirectly related to science or technology, as a result of general studies course and associated co-curricular activities.

The discussion upon the same subject as given in the BOMC Operations Manual are as follows: —

Decrease the reverse thrust to life reverse and manually apply maximum reverse thrust.

When the engine only 30 knots returns to the forward thrust.

Take more downward action on the nose wheel steering and roll control to correct roll to the right.

On the subject Right reverse thrust was applied at about 50% power and its rapid lifting was noticed when the first officer told "100 knots." Full advantage was not taken, therefore, of the available acceleration effect resulting from reverse thrust.

Statements to some extent should have been noted and summarized until an impact at 50 kt was reached whereupon the reverse thrust should have been applied to prevent engine surge and controllability difficulties. At a speed of 60 kt reverse thrust should have been canceled. When it became clear that the aircraft would not stop before reaching the end of the runway it is concluded that reverse thrust should have been applied regardless of the speed limits imposed.

The wheel brakes were operated after it was found that they had been applied, and the speed was just above 100 kt. They were applied and released several times with and without manual control selected. There is no evidence from the runway marks, the tires or from the stop measurements at the brake assembly that the brakes did not operate normally during the landing run.

It is probable that less efficient braking resulted from the reverse action of switching CRJ for the tail wheel brakes. When he laid the impression that there was no indication from looking off that it was considered that the computer brakes should have been used although it seems unlikely that this would have prevented the accident.

### Conclusions

The documentation of the accident was in order.

The crew was properly trained.

There was no pre-accident failure of the airframe, its engines or its equipment.

There was no pre-accident failure of the bulk air system.

The accident caused the runway threshold at a speed considerably in excess of the target threshold speed.

The landing technique employed by the captain was faulty.

### Opinion

The captain carried out the final stage of the approach to land at too high an air speed. As a result the aircraft touched down too far along the runway and failed to stop within the remaining length.

### Compliance with Regulations

In considering the investigation the provisions of Regulation 71(1) of the Civil Aviation (No. 100) Regulations, 1941—Statutory Instrument 1951/1051—have been compared with the following action having taken place:

The manner and extent of compliance in respect of Capt. A. T. B. Wynn

On June 10, 1965, a letter was sent to Capt. Wynn giving notice that some degree of responsibility for the accident might be attributed to him. The letter offered Capt. Wynn an opportunity of exercising his rights under Regulation 71(1) and informed him of the facilities that would be available to him for that purpose. On Aug. 17, Capt. Wynn replied stating that he wished to exercise the rights given to him under the Regulations and asked that certain information should be made available to him and his advisers—representatives of the British Air Line Pilots' Association. This information was sent on Aug. 25. A meeting took place on Dec. 7, 1964, between Capt. Wynn, last member of the British Air Line Pilots' Association, and his advisers, and representatives of the Accident Investigation Branch.

At this meeting various aspects of the case were discussed on behalf of Capt. Wynn and there was a full discussion of the powers vested on Jan. 5, 1962, before representations were received and there were several talks at a meeting held on Jan. 11, 1962. Finally on Jan. 18, 1962, Capt. Wynn's advisers together with representatives of the Accident Investigation Branch suggested the terms of a G-OPIN and discussed the significance of the words on those.

After consideration of the representations made by and on behalf of Capt. Wynn the Chief Inspector made no modification to the Opinion appearing in paragraph 6.

P. G. TREVINE  
Chief Inspector of Accidents  
Accident Investigation Branch  
Ministry of Aviation  
February, 1967

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### PROBLEMATICAL RECREATIONS 122



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—Continued

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**INTERVIEW WITH JEFFREY M. HARRIS**  
Jeffrey M. Harris is a senior research advisor at the Center for Communications Programs, University of Illinois at Chicago. He is also a senior research advisor at the Center for Communications Programs, University of Illinois at Chicago. He is also a senior research advisor at the Center for Communications Programs, University of Illinois at Chicago.

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It is hoped that all in treatment or on the way to treatment, may be able to contact J. J. B. or his family.

For details contact Anne Gargano (Agent for Philippine Airlines) 7 Park Lane London E.C.2 N.C. 0699 or 0703

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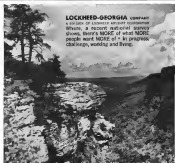
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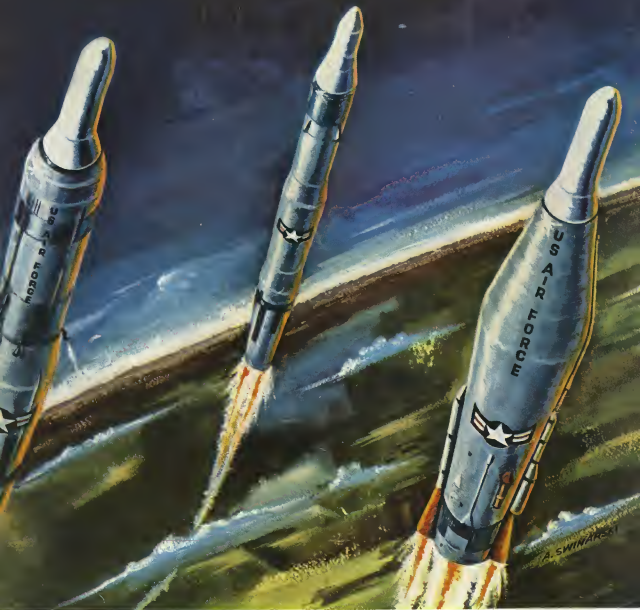
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